

A novel teaching book on an acid, and base topic

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Abstract

An electronic book on the topic of acids and bases based on Balinese local wisdom is important to develop to support blended learning. This study aims to develop and validate an electronic teaching book based on Balinese local wisdom to support blended learning in acids and bases topic. It was developed using the ADDIE model, including the stages of analysis, design, development, implementation, and evaluation. These research instruments included a document analysis sheet, interview guidelines, questionnaires, a validation sheet, a legibility assessment sheet, a practicality assessment sheet, and a learning outcomes test. The need analysis was carried out at the analysis stage. The results of the needs analysis included indicators of competency achievement, Balinese local wisdom that is relevant to the topic of acids and bases, and the opinions of teachers and students about their experiences using blended learning and learning based on Balinese local wisdom. The design stage was done by making a teaching book design. The development stage included the making of the book and tests of validation, readability, practicality, and effectiveness. The data were analyzed using descriptive and inferential analysis, namely the one-sample proportion test. Among the book's attributes are its electronic format and its foundation in Balinese folklore. It is reliable, useful, and successful in raising student learning results. It can help improve students' learning results by supporting the use of blended learning.

Keywords: Asynchronous; blended learning; chemistry learning; electronic book; local wisdom; synchronous

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1. Introduction

The spread of the Coronavirus in 2019 caused a disease known as Corona Virus Disease 2019, abbreviated as Covid-19. The World Health Organization (WHO) declared COVID-19 a pandemic on March 11, 2020 [1]. The President of Indonesia, Joko Widodo, declared the spread of COVID-19 a non-natural disaster through a Presidential Decree of the Republic of Indonesia Number 12 of 2020. Following up on this, The Ministry of Education and Culture instructed students to study from home to break the chain of the spread of Covid 19 through Circular Letter Number 15 of 2020.

In connection with the circular, blended learning is required at all educational levels. Digital platforms have become rampant and important in education [2]. To support this blended learning, learning resources are needed. One resource of learning is teaching books. Some of the books that have been developed include a multiple-representation-based chemistry teaching book [3], a case-based teaching book [4], a green chemistry teaching book [5-7], and a Science Technology Society-based book [8]. Most of them are printed books. The weakness of these books, in addition to their high cost, is that they are less practical. Likewise, they cannot support blended learning. Therefore, electronic teaching books are essential. Although research results present that students prefer printed teaching books to electronic books [9], other studies report that students prefer electronic teaching books to printed ones [10,11]. Even students get more learning outcomes from electronic books than traditional ones [12]. Electronic books provide faster access to information in learning during the COVID-19 pandemic [13]. For this reason, this research developed an electronic book based on Balinese local wisdom in chemistry to improve students' learning outcomes.

1.1 Theoretical framework

1.1.1 Blended learning

Blended learning can be defined in various ways. Bonk and Graham [14] define it as a combination of face-to-face and online learning. Picciano [15] stated that there are two important elements in blended learning, namely online and face-to-face learning. Littlejohn and Pegler [16] define blended learning as the use of technology, such as computers, the internet, and the web, in face-to-face learning. Other researchers believe that a learning system called blended learning integrates face-to-face learning with computer-mediated learning [17-19]. Another definition is that blended learning means combining the beneficial aspects of web-based learning and face-to-face learning [20]. The goal is to strike a balance between online learning and face-to-face learning. Allen et al. [21] have provided a more detailed definition, namely blended learning as a mixture of face-to-face and online subject matter content. Learning is said to be blended learning if the subject matter content delivered online is between 30 to 79 percent. In a broader context, blended learning is defined as learning that combines synchronous and asynchronous learning [22].

The blended learning environments can be designed as asynchronous and synchronous. Asynchronous learning activities are learning that takes place not in real-time. This means that students can study anywhere and anytime and on their own even giving self-reports [23,24]. On the other hand, synchronous learning activities offer students a real-time learning process.

From the description above, the definition of blended learning used in this study is learning that combines synchronous online and asynchronous online learning experiences. This definition fits perfectly with efforts to keep a distance to avoid crowds so that the spread of COVID-19 can be prevented and learning can be carried out from home.

1.1.2 Local wisdom

Local wisdom is a wise and unique local idea, value, and view [25-27] that exists and is followed by all members of the community [28]. It arises from the life experiences of all generations in a particular community [29]. It is dynamic, so there are two types of local wisdom; namely traditional and contemporary. The contemporary local wisdom does not arise from the previous generation. In contrast, the traditional local

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wisdom comes from previous generations. Although dynamic, the community can adapt to foreign cultures. Both types of local wisdom reflect the uniqueness and identity of the community [29,30].

Based on the results of a study by Wilestari [29], local wisdom includes (1) norms, such as prohibitions and obligations, (2) community rituals and habits, (3) folklore, folk songs, myths, and legends that have certain values, (4) knowledge derived from the community and spiritual leaders, (5) ancient manuscripts that are believed by the community, (6) ways to fulfill daily needs by the community, (7) tools and materials used by the community, (8) the community's environment, and (9) language. Other studies reported that it includes transportation and tourism [31] and religion [32]. Regardless of all its forms, it guides humans to have ethics and morals and love nature [33]. Based on the description above, it can be concluded that local wisdom is a value or norm adopted by the community and is a community identity and way of life. These values need to be preserved. Education is the right way to preserve it because the local wisdom is taught from generation to generation.

1.2 Related research

Research that is relevant to the study we carry out is the development of electronic teaching materials based on local wisdom. Sukma et al. [34] developed an electronic book based on local wisdom on Newton's laws in high school physics material. The local wisdom used was Manatahan and Nekeran games from Central Java. The teaching material was only tested to the level of readability (feasibility). This research has similarities with our study, namely the local wisdom-based electronic book. However, the difference with our research is that the local wisdom applied is Balinese, and it is carried out on the topic of acids and bases in high school chemistry subjects. The book was tested for its effectiveness in improving students' learning outcomes. Sofyan et al. [35] have developed a Jambi local wisdom module at the Kindergarten level. The learning model used is the area learning model. The similarity with our research is that it is electronic teaching material based on local wisdom. However, the difference is that our study uses a discovery learning model, Balinese local wisdom, and it is carried out at the high school level. Wardani and Mundilarto [36] have developed an android-based physics electronic book using the local wisdom of the Nekeran game from Central Java. The topics studied are momentum and impulse. The electronic book is in apk format (.apk). The research was only carried out up to the readability test. This research has similarities with the research we did, namely the product developed is in the form of an electronic book and uses local wisdom. However, the difference is that our study uses Balinese local wisdom, the book is in pdf format (.pdf) so that it can be read on most electronic devices, such as tablets and smartphones, and it is carried out on the topic of acids and bases in chemistry.

The books in electronic form will be able to answer the challenges of 21st-century learning, where information technology is the driving force for learning processes. With electronic books, students can develop digital skills, one of the skills that must be mastered in the 21st century. On the other hand, integrating local wisdom into the books provides a context for chemistry content so that students can learn content more easily. This was revealed by Baker and Taylor [37], who stated that learning that ignores local wisdom will cause students to have difficulty understanding science content. In addition, integrating local wisdom into the books can preserve local wisdom [38]. Wardani and Mundilarto [36] revealed that local wisdom can be maintained through education. The preservation, especially Balinese local wisdom, is critical because today's young generation prefers foreign wisdom or cultures that spread massively through social media. The younger generations' understanding of local wisdom can strengthen the spirit of nationalism and maintain national identity [39].

1.3 Purpose of the study

Based on the description above, this study aims to develop and validate an electronic teaching book based on Balinese local wisdom to support the blended learning in acids and bases topic. For this reason, many questions need to be answered through this study, including (a) what are the characteristics of the electronic teaching book based on Balinese local wisdom? and (b) what are the electronic teaching book's validity, practicality, and effectiveness in enhancing students' learning outcomes?

2. Methods and materials

2.1 Research model

The ADDIE approach produced the electronic chemistry teaching book based on Balinese local wisdom. This model consisted of five phases: analysis, design, development, implementation, and evaluation.

2.2 Participants

The sample involved in this study depends on the stages in this study. In the analysis stage, the number of teachers and students involved was 128 and 347, respectively. The validation required two content experts, a linguist, and a media expert. The book readability test included nine students. On the other hand, the book practicality test involved 32 students (15 males and 17 females) and three chemistry teachers. The book effectiveness test involved a chemistry teacher and 36 students (16 males dan 20 females).

2.3 Data collection tools

The data collection tools used in this study included a document analysis sheet, interview guidelines, questionnaires, a validation sheet, a legibility assessment sheet, a practicality assessment sheet, and a learning outcomes test. The test consisted of 30 multiple-choice items and five essay questions. All these tools have been validated by experts and were valid for collecting related data. Item analysis of the test showed a validity of 0.36-0.88, a reliability of 0.83, a level of difficulty of 0.29-0.73, and a discriminating power index of 0.22-0.76. Based on the analysis of this item, the test is quite well used to measure learning outcomes.

2.4 Data collection process

The analysis phase was carried out through an analysis of concepts, Balinese local wisdom relevant to chemistry, and teachers' and students' opinions. Concept analysis was done by reviewing the high school chemistry curriculum on the topic of acids and bases. The analysis aimed to describe basic abilities as measures of competency attainment, formulate learning objectives, and identify essential concepts on the topic of acids and bases. Analysis of Balinese local wisdom relevant to chemistry was carried out through document studies (books and Balinese lontar manuscripts) and interviews with Balinese traditional leaders. Analysis of teachers' and students' opinions was carried out by distributing questionnaires. The aspects that were asked related to the analysis of the opinions of teachers and students included their experiences using the electronic books, the context of Balinese local wisdom in the chemistry learning process, and the importance of developing the electronic teaching book based on Balinese local wisdom.

The results obtained during the analysis phase were used to design the electronic teaching book based on Balinese local wisdom on the topic of acids and bases (design phase). The book's design was related to the book's framework, type and size of the letters used, layout, selection of images to support the materials presented, order of material presentation, practicum activities, a glossary, exercises, and a bibliography.

The development phase was carried out by drafting the electronic chemistry book based on Balinese local wisdom according to the design. This book draft was then validated by two content experts, a linguist, and a media expert. The results of this validation were used to improve the draft of the developed book. The book was then tested for readability to nine students to investigate the ease of students in understanding the book's contents.

The implementation phase included the implementation of a practicality test and an effectiveness test. This practicality test was conducted to evaluate the book's use. Three chemistry teachers and 32 students evaluated the book's practicality. This practicality test was conducted in one high school with a one-shot case

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study design. On the other hand, the effectiveness test involved a chemistry teacher and 36 students in one of the high schools in Bali Province, Indonesia. The chemistry teacher who applied this book on the effectiveness test was a prospective teacher from the Chemistry Education Study Program at the Universitas Pendidikan Ganesha, Indonesia. This teacher has followed a two-month teaching practice at the school. This study's approach was a one-shot case study. The discovery learning model was employed in the application of the book. The model went through the following stages: stimulation, problem identification, data collection, data processing, verification, and generalization. The implementation of learning was done through asynchronous and synchronous blended learning. The platform used for asynchronous learning was Google Classroom, while the platform used for synchronous learning was Google Meet. Before learning, the students' worksheets and the electronic teaching book based on Balinese local wisdom were sent via the Google Classroom platform. Students learned and did the tasks in the worksheet at home (asynchronous learning). The asynchronous steps of the discovery learning model included stimulation, problem identification, and data gathering. Then, data processing, verification, and generalization took place during synchronous learning. The teacher's role in this condition was to facilitate and mediate students to understand chemistry concepts and overcome their learning difficulties. The learning took place for four meetings (4 x 90 minutes). After the lesson, the post-test was carried out. The research instrument in this effectiveness test was a test of learning outcomes in the cognitive domain.

The evaluation phase was carried out in all phases. Evaluation in the analysis phase included evaluation of data on the elaboration of basic competencies into indicators of competency achievement, formulation of learning objectives and essential concepts, exploration of Balinese local wisdom contexts relevant to chemistry, and identification of teachers' and students' opinions about their experiences in implementing the electronic teaching books and Balinese local wisdom. Evaluation at the design phase included an evaluation of the developed book framework. Evaluation at the development phase included evaluation of the validity and readability of the developed book. Evaluation at the implementation phase included evaluating the practicality and effectiveness of test results.

2.5 Data analysis

The data obtained were in the form of the elaboration of basic competencies into indicators of competency achievement, the formulation of learning objectives, the essential chemistry concepts, the Balinese local wisdom contexts relevant to chemistry, and teachers' and students' opinions about electronic chemistry teaching books based on the local wisdom, the design of electronic book framework, expert validation scores, the readability test scores, the practicality test scores, and the effectiveness test scores. The data obtained at the analysis, design, and development phases (validation and readability tests) were analyzed descriptively. Meanwhile, the data obtained during the implementation phase, namely the practicality and effectiveness tests, were analyzed using descriptive and inferential statistics (one-sample proportion test). A 5% significance level was used for this inferential statistical test. The scoring threshold employed was 70. SPSS version 25 was used for data analysis. The book was effective if more than 85% of students received a minimum score of 70. However, before the one-sample proportion test was conducted, it was necessary to test the normality of the data.

3. Results

The design of the book has the characteristics that it is made in electronic form and is based on Balinese local wisdom. This design is based on the study's results obtained at the analysis stage. The design of this book comprised the making of the book outline, which includes the introduction, contents, and closing sections. The introduction section comprises the cover page, preface, table of contents, table of pictures, instructions for using the book, basic competencies, main contents, and indicators of competency achievement. The content section comprises an introduction to the materials, a description of the materials covering the theories of acids and bases, ionization of acids and bases in water, degrees of acidity (pH), acid and base indicators,

and acids and bases in the context of Balinese local wisdom. The closing section covers a summary, a competency test, a glossary, and a bibliography.

The design of this book is based on the results obtained at the analysis stage, including analysis of the chemistry curriculum, the Bali local wisdom contexts relevant to acid and base topics, and opinions of teachers and students about the electronic book and learning based on Balinese local wisdom. The results at the analysis stage are as follows. The results of the analysis of the chemistry curriculum include elaborating basic competencies into indicators of competency achievement, learning objectives, and essential chemistry concepts (Table I.) Table I shows that there are as many as ten indicators of competency achievement resulting from the basic competencies. These ten indicators can represent basic competencies so that the measurement results of these indicators can reflect the achievement of basic competencies.

TABLE I
CURRICULUM ANALYSIS RESULTS

Basic competencies	Indicators of Competency Achievement	Essential concept
Describing acids and bases, their strengths in ionization equilibrium, and their roles in solutions	<ol style="list-style-type: none"> 1. Describe how the idea of acids and bases came to be. 2. Comparing Arrhenius, Bronsted-Lowry, and Lewis' theories of acids and bases. 3. Using an acid constant (Ka) or a base constant (Kb) to connect the strength of acids or bases to the degree of ionization (α). 4. Determining the pH of an acidic or basic solution. 5. Describing several types of acid and base indicators. 	<ol style="list-style-type: none"> 1. The concept of acids and bases according to Arrhenius 2. The concept of acids and bases according to Bronsted-Lowry 3. The concept of acids and bases according to Lowry 4. Ionization of strong acids and strong bases 5. Ionization of weak acids and weak bases 6. The degree of acidity (pH) of an acidic solution 7. The degree of acidity (pH) of an alkaline solution 8. The degree of acidity (pH) of a neutral solution 9. Indicators of artificial acids and bases 10. Natural acid and base indicators
Analyzing the spectrum of pH variations in some indicators taken from natural sources	<ol style="list-style-type: none"> 1. Making natural indicators using natural products. 2. Constructing a test to identify acids and bases using natural indicators. 3. Utilizing natural indicators to identify acids and bases. 4. Concluding acids and bases based on experimental data. 5. Communicating the results of experiments to identify acids and bases. 	

Research findings on the Balinese local wisdom contexts that are relevant to chemistry on the topic of acids and bases are shown in Table II. The results in Table II indicate that kitchen ash and quicklime are alkaline, while star fruit, tamarind, and palm wine (fermented liquid produced from the sap tree) are acidic. Generally, the use of these materials applies the concept of a neutralization reaction.

TABLE II
THE BALINESE LOCAL WISDOM CONTEXTS RELEVANT TO THE TOPIC OF ACIDS AND BASES

No.	Balinese local wisdom
1	Rubbing ash (containing calcium oxide) is used to clean household furniture. This rubbing ash in water will produce a base capable of emulsifying the oil.
2	<i>Nginang</i> is the activity of chewing betel leaves accompanied by quicklime, areca nut, and gambier. Quicklime with saliva produces a base that can neutralize the acid produced from the fermentation process against the remaining food in the mouth.
3	Bee stings are treated with prestige (quicklime). The venom of a bee sting is acidic, while quicklime is alkaline.

4	Snake bites are treated with papaya latex and <i>pamor</i> (quicklime). Snake venom contains acidic compounds, while quicklime is alkaline.
5	Star fruit, salt, and tamarind reduce or stop opium addiction. Opium is alkaline, while star fruit and tamarind contain acid.
7	<i>Tuak</i> (fermented liquid produced from the sap tree) is a traditional drink that is acidic.
1	Rubbing ash (containing calcium oxide) is used to clean household furniture. This rubbing ash in water will produce a base capable of emulsifying the oil.

The analysis of teachers' opinions shows that chemistry teachers had experiences in applying electronic books and learning models based on Balinese local wisdom. However, they have never applied electronic books based on Balinese local wisdom to chemistry subjects. Students also showed similar results that they had been taught with electronic books and local wisdom-based learning models. However, they have never been taught to use the electronic book based on Balinese local wisdom in chemistry subjects.

Content validation of the book design included relevance, content truth, content updating, local wisdom, presentation techniques, and support. Data analysis resulted in a valid book in terms of content (0.69, maximum score of 1.00). Meanwhile, language validation covered straightforward, communicative aspects, conformity to language rules and students' development, and consistent use of formulas, symbols, or terms. In contrast, media validation involved cover, content, and layout design. The book was classified as very valid concerning language (3.83, scale of 4.00) and very valid regarding the media (3.56, scale of 4.00). The readability test aimed to determine the readability level of the book. The readability test results revealed that the book received a very good rating (3.46, scale of 4). The results of the practicality test indicated that the book was classified as very practical (3.56, scale of 4).

It was important to check the normality of the learning outcome data before assessing the proportion of one sample on the effectiveness test. The data were normally distributed according to the normality test results ($p > 0.05$). Furthermore, the one-sample proportion test findings presented that the proportion of individuals achieving the minimum completeness criteria of 70 was more than 85% ($p < 0.05$). The number of students who reached the minimum completeness criteria was 91.67% (33 of 36 students). Thus, it can be said that the book successfully enhances students' learning outcomes.

4. Discussion

The developed books have the following characteristics. First, it is made in an electronic form. The electronic form allows it to be copied and distributed easily [40,41]. It can display color images, tables, text, etc. In addition, it can be stored on electronic devices, such as laptops, tablets, and smartphones. With laptops, tablets, and smartphones that are portable, it can be carried easily. The flexibility of the book in electronic form allows students to study it anywhere and anytime. This motivates students to learn. The electronic form makes it paperless. This results in less cutting of the trees needed to make paper. Paper is the primary material for printing books. A further consequence is a reduction in global warming [42]. Other advantages of the electronic book are the reduction of paper waste [43] and cost savings. Reducing paper waste can reduce environmental pollution. Second, it is based on Balinese local wisdom. This wisdom provides context to the acid and base topic. Integrating the Balinese local wisdom into chemistry content can increase students' love for their local wisdom/cultures and preserve the local cultures themselves. In addition, it can also improve nationalism and develop a national identity. This was confirmed by Meliono [39], who revealed that the local wisdom that is integrated into teaching materials can build values such as nationalism, harmony, and national morality. Jamiah et al. [44] stated that local wisdom can maintain national defense, strengthen nationalism, and build national identity.

This electronic book based on Balinese local wisdom has been tested for validity, practicality, and effectiveness in improving students' learning outcomes. The validity test showed that the book was valid in content, language, and media. The readability of the book was classified as very good. The practicality of the

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book was classified as very practical. Likewise, it effectively improved the learning outcomes of high school students. These results were supported by previous research which stated that electronic books based on local wisdom can improve students' learning outcomes [45-48].

The effectiveness of the electronic books based on Balinese local wisdom is due to several reasons. First, the electronic form of the book allows students to learn acid and base content more easily and faster. The presentation of content makes the book more attractive. This will motivate students' learning. This motivation will ultimately affect students' learning outcomes. This is supported by the results of previous studies, which state that electronic books can improve students' motivation and learning outcomes [49-54]. Second, the book based on Balinese local wisdom allows students to face relevant contexts to students' real lives. The contexts of this local wisdom can bring chemistry content closer to its application in everyday life. This helps students understand chemistry content more easily. These results are in line with the previous studies [55,56]. The results of other studies also report that books based on local wisdom can increase democratic values [57], critical thinking skills [58,59], higher-order cognitive abilities [60], social behavior [56], and reading and writing skills [61].

One of the Bali local wisdom contexts integrated into the acid and base content is the *Nginang* event. *Nginang* is the habit of chewing betel leaf with prestige (quicklime), areca nut, and gambier. The quicklime with saliva produces an alkaline solution. This solution neutralizes the acids produced by the fermentation of food residues by bacteria in the mouth. It is simpler for students to comprehend the content being studied when the Balinese local wisdom is incorporated into the acid and base content. In addition, this local wisdom can be preserved through education.

The results presented in this study can fill in the gaps of previous research. The limitations of Sukma et al., [34] research have been solved by using the context of Balinese local wisdom on the topic of acids and bases in chemistry subject. The limitations of Sofyan et al.'s [35] research have been overcome by using the Balinese local wisdom and the study was conducted at the high school level. Finally, the limitations of Wardani and Mundilarto's [36] research have been overcome by integrating the Balinese local wisdom into acids and bases, and the book is in pdf format (.pdf).

This study contributes to the development of science and technology in the era of the Industrial Revolution 4.0. The electronic book based on the Bali local wisdom can be a learning resource for blended learning. In the present and future, blended learning is compulsory learning that will be carried out in educational institutions. This is because of the rapid development of technology and the internet. In addition, this book can save the government and the community budget because this book does not require printing and distribution costs. Also, this book can reduce waste production and prevent global warming. Another contribution that is no less important is preserving local wisdom amidst the hegemony of the entry of foreign cultures which can also increase nationalism and strengthen national identity.

This study still has limitations. The research effectiveness test only uses a one-shot case study. The other limitation is that the teacher in this study is a prospective teacher with less teaching experience. In addition, this study was only conducted on the topic of acids and bases.

5. Conclusion

The electronic chemistry teaching book based on Balinese local wisdom was developed to accommodate two interests. The chemistry book created has characteristics, namely, it is made in electronic form and is based on Balinese local wisdom. It meets the valid criteria regarding content, language, and media aspects. Also, the readability of this book was very good. In addition, this book was also reasonably practical. The conclusions of the effectiveness test revealed that this book successfully enhanced high school students' learning outcomes.

This book is a valuable learning tool for blended learning in which the preferred method of education for the twenty-first century is blended learning. Further study that can be done to overcome the limitations of

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this study include (1) the effectiveness test of the book should use a quasi-experimental design, (2) the experimental and control groups should be taught by two experienced teachers with almost the same conditions, and (3) the book is made for other topics of chemistry.

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