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Developing textbook of basic science concepts based on ethnoscience *Dalihan Natolu*

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Abstract: This research aimed to develop a textbook on basic science concepts based on ethnoscience that is valid, practical, and effective. The research method was R&D and implemented five stages of the ADDIE model. The instrument used in this research is a local wisdom-based textbook validation sheet consisting of a material media, and language validation sheet. There are three experts as a validators according to their field of science, an ethnoscience-based textbook practicality sheet. This sheet serves to determine the practicality of valid textbook design and the effectiveness sheet for ethnoscience-based textbooks based on Natolu ethnoscience. The research results show that the average value of the validity test results for textbooks on basic science concept based on ethnoscience is 81.26% (valid). The effectiveness results show a score of 3.5, which means the textbook developed is included are effective. Based on those results, it can be conclude that the ethnoscience-based basic concept of science textbook is valid, effective, and practical so it is suitable for use in the learning process in the Basic Science course.

Keywords: basic science; ethnoscience; textbooks; R&D

1. Introduction

The basic concepts of science are one of the mandatory subjects in the Primary School Education Department at HKBP Nommensen Pematangsiantar University (UHKBPNP) with three credits. So far, learning basic science concepts in the study program does not have a standard reference book. Therefore, each lecturer has a perception of what material is important to teach. This has an impact on the material that students receive will be different. The existence of textbooks as a reference is very fundamental in accelerating learning with examples and instilling concepts (Aprilia, 2021; Nurhikmayati, 2019). This results in the initial knowledge that students have from previous learning experiences as if it is separate from the newly received knowledge (Erwiza et al., 2019). In addition, efforts to assimilate old knowledge and new knowledge to form students' conceptions cannot be carried out optimally (Coman et al., 2020; Hendrowati, 2015) because new knowledge obtained as a result of the process of assimilating initial knowledge and new experiences is not realized (Kurniasih et al., 2016).

On the other hand, student diversity is also a challenge faced in learning basic science concepts (Ardiansyah et al., 2020; Retno & Yuhanna, 2016). The initial mapping results show that in general students consist of various ethnic groups, but the Batak Toba tribe dominates. Furthermore, they come from different secondary education backgrounds, such as vocational schools and general schools, both from science and social science concentrations. The interview results showed that the majority thought that the lecture material was elementary-level material so it was easier compared to other study programs. Therefore, students' interest in this science concept is still relatively low

Educational background also influences students' conceptual understanding (O'Connor et al., 2016; Zidny et al., 2021). Students with a vocational school background

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have lower preconceptions of learning science concepts compared to students who come from the science department (Fatimah, 2017; Hasnawati et al., 2022). Students from the science department are familiar with science phenomena so it is easier to learn higher-level science material, while students from vocational schools have lower learning preconceptions so they need extra work to learn basic elementary science concepts to get maximum results (Lefudin & Hakim, 2020). Textbooks are written based on the author's knowledge and opinions without taking into account the interests, motivation and ability level of students. As a result, the textbook cannot maximize understanding of the concept.

On the other hand, several efforts made by researchers to increase learning motivation and understanding of concepts (Cetin-Dindar & Geban, 2017; Himschoot, 2012) by developing teaching materials that are prepared based on local cultural characteristics (Nurrahmah & Ningsih, 2018; Rahmatih et al., 2020). Researchers believe that contextualizing teaching materials can bridge students' initial knowledge with the new knowledge they will acquire (Liu & Stapleton, 2020; Zidny et al., 2021). In other words, developing textbooks based on local culture can be a useful way to create a contextually meaningful learning process for students and motivate them to love the existing culture more (Aprilia, 2021). However, learning that links cultural knowledge is rare and very few, apart from learning about art and culture (Lubis & Harahap, 2017). Combining material with culture can increase knowledge of local wisdom. Culture-based learning is a way to create a learning atmosphere and design learning activities that link culture to learning (Saputra & Ekawati, 2017; Sumartias et al., 2020). Students feel happy and appreciated for their existence and differences in their cultural knowledge and experiences because they are recognized and integrated into the learning process.

Several previous research results indicate that the development of teaching materials with local wisdom is highly recommended to continue and be developed because it helps facilitate students to understand the concepts of the learning materials (Ade & Affandi, 2016; Ramdiah et al., 2020; Sumartias et al., 2020). On the other hand, the development of teaching materials using local Batak wisdom is still relatively limited (Lubis & Harahap, 2017). Fitri et al (2023) has integrated the *Dalihan Natolu* philosophy into a collaborative learning model. Furthermore, the integration of local values of *Dalihan Natolu* is indicated to be able to improve social relations and ensure the creation of balance and harmony in schools (Arwita et al., 2017). However, there is still not much implementation and integration in science learning, even though science concepts have a high urgency in students' daily lives.

The strategy to overcome the problems above is to conduct research on the development of basic science concepts textbooks based on *Dalihan Natolu's* ethnoscience which can be used to increase students' interest in learning in basic science concepts courses (Zidny et al., 2020). *Dalihan Natolu* is a pattern of social interaction of the Batak tribe in social relations between individuals, families, and society (Arwita et al., 2017; Fitri et al., 2023; Harianja & Sudrajat, 2021). The kinship system consists of *Hula-hula*, *Dongan Tubu*, and *Boru* which have different duties and functions, both rights and responsibilities. Likewise, the material in the textbook on basic science concepts can be developed based on *Dalihan Natolu's* ethnoscience so that learning is not passive. Because of this academic review, this research was carried out to develop a textbook on basic science concepts based on *Dalihan Natolu's* ethnoscience that meets the criteria of being valid, practical, and effective. So it is hoped that with the development of this textbook on basic science concepts, students will better understand the material and at the same time become aware of *Dalihan Natolu's* ethnoscience.

2. Materials and Methods

2.1 Research Design

This research was conducted at Primary School Education Department – HKBP Nommensen University Pematangsiantar, North Sumatera. This R&D research using

ADDIE model (Branch, 2009). This model has been widely used in developing text design, audiovisual media, and computer-based learning media. The ADDIE development model is considered easier to use because it has been developed systematically (Serevina et al., 2018). Apart from that, this model is also programmed to solve learning problems related to learning media. This model consists of five steps, including analyze, design, develop, implement and evaluate.

The instruments used in this research consisted of (1) ethnoscience-based textbook validation sheets including material validation sheets, media validation sheets, and language validation sheets; (2) practicality sheets for ethnoscience-based textbooks. This sheet determines the practicality of valid textbook design; (3) effectiveness sheet for ethnoscience-based textbooks. The teaching material product developed is effective if it meets the percentage of classical completeness or completeness criteria and students respond positively (Novitasari et al., 2017).

The initial step in this research was to prepare a textbook on basic scientific concepts based on *Dalihan Natolu's* ethnoscience and validate the prepared book with media, content, and language experts. After receiving suggestions for improvement, the book was revised again before being tested on students. The collection of materials and data followed the needs analysis to identify whether the book on basic science concepts based on *Dalihan Natolu's* Ethnoscience that was developed was valid, practical, and effective. Furthermore, the next step is product design development.

Limited trials were carried out on students using the basic science concepts textbook used which had undergone revisions from material experts and media experts. This aims to determine the response of users (lecturers and students) to the use of textbooks using a Guttman scale assessment questionnaire. The trial subjects were limited to one lecturer and ten students who taught the Basic Concepts of Science course. The lecturer for the Basic Concepts of Science course chose test subjects from students to avoid researcher subjectivity.

2.2 Research Subjects

The expert validation stage was carried out to assess the suitability of the media to be used in the learning process for the Basic Science Concepts course at university. Some experienced experts carry out this stage to evaluate new product designs. Design validation include two material experts and two media experts. Each expert was asked to rate the product to identify its advantages and disadvantages. Material experts have qualifications as university lecturers in the field of scientific studies. Media expert qualifications include having knowledge, skills and experience in understanding the characteristics of media.

2.3 Data Collection Techniques and Types of Instruments

This instrument is used to obtain data on the level of effectiveness of textbooks developed from learning outcome test sheets. The data that has been obtained is analyzed and then used to revise the textbook being developed so that a textbook is obtained that meets the specified criteria, namely valid, practical and effective. The results of the expert assessment on the validation sheet are given a score for each item. The categorization criteria for textbook validity are as shown in Table 1.

Table 1. Criteria for categorizing textbook validity

No	Percentage (%)	Category
1	85.1 - 100	Very valid, or used without revision
2	70.1 - 85	Quite valid or usable but needs minor revisions
3	50.1 - 70	Invalid, the basis is that it is not used because it needs major revision
4	0 - 50	Invalid, should not be used

Validity tests are carried out on aspects, namely content suitability aspects, material suitability aspects, linguistic aspects and local wisdom aspects. Determining the validity value is modified as explained in Formula (1), further analysis is carried out by combining calculations using Formula (2). V is the average of the three validation scores (Kurniasih, 2016).

$$\text{Validation value} = \frac{total\ score\ obtained}{maximum\ score} x100\% \quad (1)$$

$$v = \frac{val1+val2+val3}{3} \quad (2)$$

Analysis of the practicality of ethnoscience-based textbooks was carried out by giving a score for each item with answers of strongly agree (5), agree (4), quite agree (3), disagree (2), and disagree (1). The following are the criteria for categorizing the practicality of textbooks as shown in Table 2. Meanwhile, analysis of the effectiveness of local wisdom-based modules. The following are the criteria for categorizing the effectiveness of textbooks as shown in Table 3.

Table 2. Criteria for categorizing textbook practicality

No	Mark	Practicality Category
1	4 ≤P≤ 5	Very practical
2	3 ≤*P*< 4	Practical
3	2 ≤ P< 3	Not practical
4	1 ≤P< 2	Not practical

Table 3. Criteria for categorizing textbook effectiveness

No.	Mark	Effectiveness Category
1.	4 ≤E≤ 5	Very effective
2.	3 ≤ E< 4	Effective
3.	2 ≤ E< 3	Less effective
4.	1 ≤E< 2	Ineffective

3. Results

The research results show that the Basic Science Concepts textbook developed has gone through a series of development stages and has been validated by experts in the field and has been tested. The textbook being developed consists of an introductory page, main part and closing page (Lefudin & Hakim, 2020; Rofieq et al., 2021). The introductory page in the textbook consists of a book cover. The cover of the textbook being developed equipped with an ISBN number. The introductory page in the textbook consists of a book cover as shown in Figure 1.

The image on the cover of the textbook shows the local wisdom of *Dalihan Natolu*. In the book, there are activities for each material contained in it, namely in the form of forming group discussions by following the natolu pretext interaction pattern (Fitri et al., 2023; Harianja & Sudrajat, 2021). This pattern was developed with the hope that students

understand the concept of *Dalihan Natolu* as local wisdom that must be protected and preserved (Permatasari et al., 2021; Suastra et al., 2017). The basic science concepts textbook consists of nine chapters, where in each chapter there is an integration of the application of *Dalihan Natolu* in student activities.

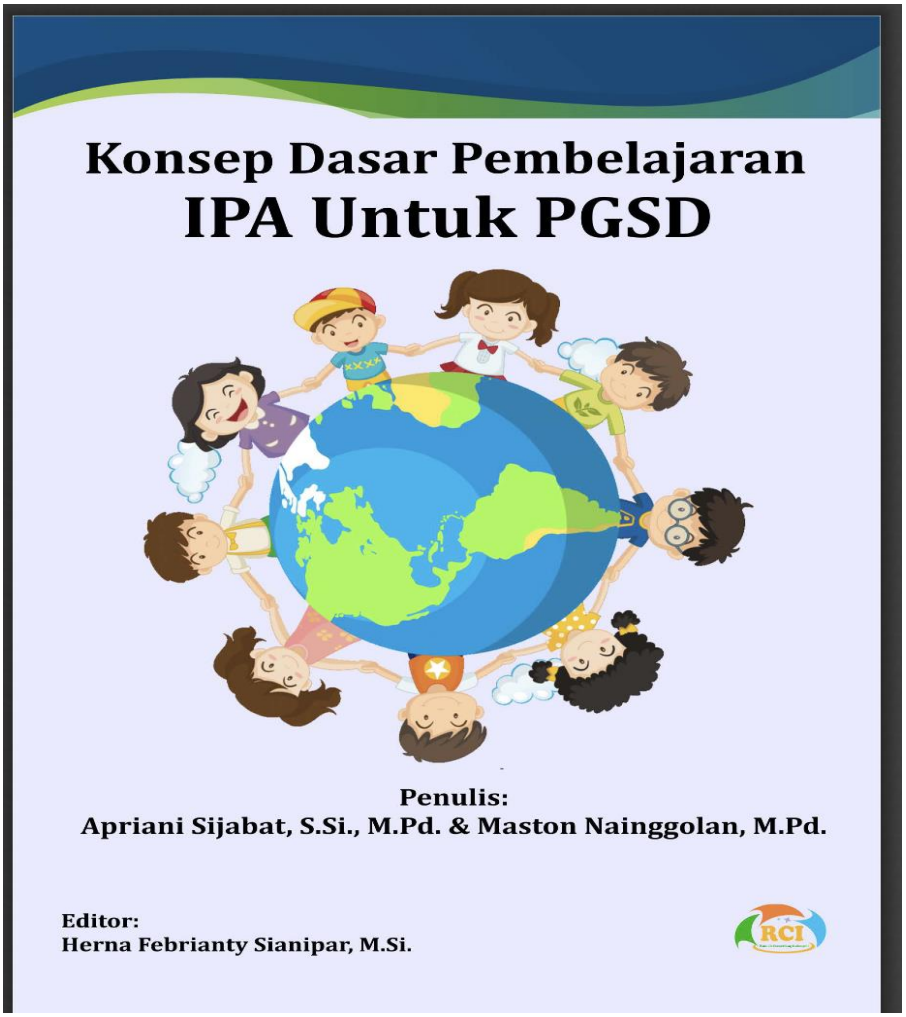

Figure 1. Cover of available basic science concepts textbooks

The core part of this book consists of subtitles, descriptions of material based on *Natolu's* ethnoscience (Harianja & Sudrajat, 2021), example questions (Wolverton et al., 2014), additions to the latest science or technology and practice questions related to the sub-material being studied. As well as the closing page of the required attachments, bibliography, and author biodata. Validation is used to show the level of validity of a media as shown in Table 4. In this study, an assessment questionnaire was used to validate the learning media created. Product validation was carried out by involving several validators, including material experts and two media experts. Based on the validity test using the validity assessment sheet instrument, the results in Table 4.

Table 4. Validation test results

Component Aspects	Percentage (%)	Category
Aspects of content suitability	82.34	Valid
Aspects of material presentation	80.65	Valid
Linguistic aspect	81.67	Valid
Aspects of local wisdom	80.40	Valid
Average	**81.26**	**Valid**

Table 4 shows that the average value of the validity test results for basic science concepts textbooks based on ethnoscience is 81.26% with valid criteria according (Novitasari et al., 2018). This shows that the textbooks developed in this research are valid. Good components of appropriateness of content, presentation of material, language, and local wisdom. Revisions are carried out in accordance with the responses and suggestions given by each expert.

4. Discussion

Teaching materials have an important role in learning so the development of teaching materials must be appropriate and learning needs to improve students' abilities (Fauziyah & Jailani, 2014; Tinja et al., 2017). The process of developing teaching materials has certain rules and regulations by the development model carried out. Similar research was also carried out by Pamessangi (2022) and Tajuddin et al (2020) who developed Arabic reading books based on community stories was suitable for students as additional reading material in next to the textbook. Based on the analysis results, the average validation score was 81.40% with valid criteria. This shows that the textbooks created are suitable for use by teachers and students in the learning process as well as the aspects desired in this research. These aspects include aspects of the suitability of content, presentation of material, language, and presentation of material. Judging from the content feasibility aspect, the textbook was declared valid by validators with an average score of 82.34%. This shows that the material contained in the textbook is by the competency standards, basic competencies (BC), indicators and learning objectives to be achieved. This was confirmed by the Kemendikbud (2016) that textbooks are prepared based on competencies that must be achieved by students. Thus, textbooks must come from the curriculum.

Judging from the aspect of material presentation, the textbook was declared valid by the validators with an average score of 80.65%. This shows that the material contained in the handout is arranged systematically (Prastowo, 2015). This shows that the handout design as a whole is good and attractive, the content layout, cover appearance, picture illustrations and information are developed based on the two constituent elements, namely the title and supporting information (Sarah & Maryono, 2018; Tanner, 2012). The title contains matters relating to identity (Vong & Kaewurai, 2017), while the supporting information concerns the author's willingness and skills in presenting the material by providing clear sources and references (Hollweg et al., 2000). Judging from the linguistic aspect, namely components related to the use of standard sentences, letters and terms. The handout developed included valid criteria with an average value of 81.67%. This shows that the language used in the textbook is in accordance with correct Indonesian language rules, both in terms of readability and clarity of information. This is emphasized Daryus et al (2021), that when writing textbooks, try to ensure that the sentences used are not too long.

Judging from the ethnoscience aspect, the textbook is categorized as valid with an average score of 80.40% because the textbook is equipped with local wisdom from the language found in the surrounding environment so that students can easily understand the material and apply it in their daily lives because it is linked to the students' culture (Arwita et al., 2017; Dukut, 2019; Grumney, 2022). Overall, the textbook on basic science concepts based on local wisdom, has met the valid category with a score of 81.26%, however minor revisions are still being made to improve the textbook in accordance with the suggestions given by validators from material experts and media experts (Nurrohmah et al., 2018; Pang, 2022). The revision actions taken are (a) clearly explanations for each picture, (b) clarifying the local wisdom of rhree arguments in the material, and (c) give a statement to the image in the information column.

For the effectiveness test data, data were obtained as shown in Table 5. The assessment of book users by lecturers teaching elementary science learning courses and 40 students taking science learning courses was found to be in the effective category. The recapitulation of average gains is summarized in Table 5.

Table 5. Textbook effectiveness value

Criteria	Effectiveness Value
1. Appropriateness of the book by lecturer users	3.4
2. The suitability of the book for student users	3.6
Average	**3.5**

The average result of effectiveness shows a value of 3.5, which means that the ethnoscience-based textbook is declared effective. This means that textbooks have been able to fulfill interests which include an attractive book appearance, making students enthusiastic about learning, not being boring, and supporting mastery of basic science concepts (Nisa et al., 2021). Textbooks are able to motivate and influence attitudes and learning outcomes. In terms of presentation, the material is conceptual, easy to understand, and guides students to discover their own concepts (Lefudin & Hakim, 2020; Sa'diyah & Ambarwati, 2014). Encourages interest in discussion and the contents of the book contain evaluations that can test how far students understand. The linguistic aspect is also in accordance with the rules, namely the sentences and paragraphs used in the book are clear and easy to understand. The language used is simple and easy to understand. The letters used are simple, quite attractive (Daryus et al., 2021).

With the existence of a textbook on Basic Science Concepts based on ethnoscience which is valid, effective and practical, the product will be useful for the learning process of the Basic Science Concepts course and will be useful for readers who need references in research in the field of science learning. In the learning process, students are also able to strengthen memory, understand concepts, think critically and develop knowledge. As is known, science in elementary schools is a program to instill and develop scientific knowledge, skills, attitudes and values in students (Jumriani & Prasetyo, 2017; Nurhikmayati, 2019).

5. Conclusions

Based on the results of research on the development of textbooks on basic science concepts based on ethnoscience, Dalihan Natolu, it can be concluded that this development research has produced textbooks that are valid, practical and effective. Suggestions that can be written to other researchers are to design textbooks on the same subjects but in combination with other approaches. Other researchers can also design various other types of books on the same subject or can develop textbooks on different subjects.

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