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THE DEVELOPMENT OF NATURAL CHEMICAL SUPPLEMENTARY BOOKS BASED ON LOCAL CONTENT

Isti'anah, Dini Hadiarti, Tuti Kurniati
Chemical Education Study Program of FKIP
Universitas Muhammadiyah Pontianak
Email : istiana42561@yahoo.com

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Abstract

Natural Chemistry Learning Resources in the form of PowerPoints, scientific journals and books have not accommodated the needs of students. This research aims to provide natural chemical supplement books on the Premna genus as a source of antimicrobial metabolites that are feasible to use based on aspects of validity and practicality. The development model utilized in this study is the Dick and Carey model which includes: identifying learning objectives, analyzing learning, analyzing learners and contexts, formulating specific learning goals, developing assessment instruments, developing learning strategies, developing and selecting teaching materials, designing and developing formative evaluation, and revising the product. The researcher applied research techniques in the form of interviews and observations. The tools used in this research were interview guidelines, student and lecturer response questionnaires, and practice questions in groups. Based on the results of the assessment by material experts and media specialists, this teaching material has a validity value of 91.6% and the practicality of individual trials is 84.51% and small group trials are 76.39%.

Keywords: *Antimicrobial, supplementary books, local content.*

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The learning process requires to be supported by contextual learning resources developed from the study program profile in a book. Books are one of the most widely used education resources in the learning process (Prastowo, 2015). The advantages of the book developed from laboratory research according to Pambudiono et al (2016) are books that are packed with colored covers and accompanied by research results so that it is more interesting to read with the latest, applicable and contextual material.

Information obtained from interviews on January 2, 2017, toward six students with high, medium, and low academic abilities stated that learning resources used in the subject matter of Natural Chemistry were in the form of PowerPoints and articles from scientific journals. The material presented in the PowerPoint contains brief information so that students must record the explanations delivered by the lecturer quickly. Generally, the articles utilized for discussion and assignments are in English, so students do not understand the information conveyed and are difficult to translate in Indonesian that is effortless to be understood. The articles are obtained from scientific journals by downloading from the internet which is very dependent on wifi connections located in the University of Muhammadiyah Pontianak (UM Pontianak) or internet quota that is owned by students.

Information about the effectiveness of learning resources is supported by the outcomes of interviews with lecturers on January 4, 2017. The PowerPoint applied contains

brief information summarized from scientific journals and books. The existing book does not cover all the material taught in Natural Material Chemistry and only leads to the biosynthesis of secondary metabolites. Articles obtained from various scientific journals in English and Indonesian are used for discussion material, assignments, and final semester examinations. Learning resources in the form of PowerPoint, articles from scientific journals, and books support each other because not all the information needed is in one learning source. The learning objectives of Natural Materials Chemistry are to estimate plant acts as a drug based on a study on the community beliefs, previous research, phytochemical content, and plant activity with the same genus and the method of testing methods both in vivo and in vitro. From the results of the study of Natural Material Chemistry for the 2015/2016 Academic Year, it was perceived that an A value of 13%, a B value of 37%, a C value of 27%, a D value of 20%, and an E value of 3%. Looking at the problems faced by students and lecturers in the form of learning resources is still not organized and in accordance with the learning objectives, it is inevitable to produce a learning resource for Natural Chemistry that can overcome these obstacles, namely learning resource books..

The material taught in the chemical subject matter of nature is secondary metabolites, extracting, isolating, identifying, and activity of plants in-vitro and in-vivo. In both in-vitro and in-vivo activities, there are sub-topics about the antimicrobial

movement. This antimicrobial activity test is essential to be studied to look for alternative antimicrobial treatments other than commercial drugs that cause side effects such as skin infections, hyperkalemia, hypokalemia, hypomagnesemia, seizures, headaches, redness, diarrhea, and vomiting (Apsari and Adiguna, 2013). In addition, the weather in West Kalimantan is very supportive for the growth of bacteria and fungi, as well as the potential of plants in West Kalimantan that have been shown to be antimicrobial, making this material even more important to be taught to students. The genus *Premna* plant has antimicrobial activity is *Premna serratifolia* (Rajendran R and Basha NS, 2010; Rajendran R, 2010; Isti'annah, 2015; Sigh, 2011; Ratnaweera et.al., 2016; Wahyuni S. et al, 2014) , *Premna odorata* (Arollado et. Al., 2015; Arollado et. Al., 2017; Lunesa et. Al., 2016) and *Premna herbacea* (Narayanan et. Al., 2000; Kumar et.al., 2013; Murthy et .al., 2006; Dhamija Isha et.al., 2014). This *Premna* genus contains alkaloid compounds, flavonoids, tannins, glycosides, steroids, saponins in *Premna serratifolia*, *Premna herbacea*, and *Premna odorata* (Rajendran R, 2010; Arollado et.al., 2015; Thirumalai et.al., 2009)

Learning resources that are limited to PowerPoint, articles from scientific journals, and books that have not accommodated student needs result in the requirement to develop further comprehensive learning resources to overcome these problems. The development of learning resources is an alternative in the genus *Premna* as an antimicrobial that re-

quires to be presented in book. The book used in learning Natural Chemistry is required to assist students and lecturers so that learning objectives can be achieved properly.

Research on the development of books from laboratory research has been conducted by Pambudiono et al (2016) on bioremediation of heavy metal cadmium used in Biotechnology courses. This book is declared feasible with validity results of 91.6% and practicality of 85.56%. In addition, Tampubolon E. H. M., (2016) has developed a book on chemical elements based on local wisdom with a validity percentage of 64.28%, the practicality of 39.9%, and effectiveness of 68.1%. Research conducted by Wulanzani U. T, et al. (2016) on the development of books on the subject matter of Pacing Plant-based Biotechnology (*Costus Speciosus* Smith) as antifertility has a validity of 94.46% and practicality of 91.73%. Furthermore, Fadilah R.E, et al. (2016) conducted a book development study on the subject of evolution with the validity of 92% and practicality of 81%. Pupitasari et al (2016) also conducted a book development study on in silico-based cell biology courses with validity results of 96.19% and practicality of 93%. The success of these studies in producing books as learning resources from laboratory research has made the researcher believes that product development can expedite and provide comprehensive understanding for students. The use of long-term supplementary books can enhance understanding about antimicrobials in various types of plants.

METHOD

Form of Research

The form of research is Research and development (R & D) applying the Dick & Carey development model. The stages of developing the Dick and Carey model in this research hold nine stages, specifically identifying learning objectives, conducting learning analysis, analyzing learning and context, formulating specific learning goals, developing assessment instruments, developing learning strategies, developing and selecting learning resources, designing and developing evaluations formative, and revising the product. The steps taken refer to the study of Pambudiono et al (2016), Harijanto (2007) and Puspitasari et al (2016).

Population and Sample

The population in this study were all learners studying the Natural Materials Chemistry subject in the 2016/2017 Academic Year of Chemistry Education Study Program FKIP UM Pontianak. The number of samples in individual trials was carried out on 6 people and a small group scale trial was conducted on 9 people (Harijanto M., 2007).

Research Procedure

The development of supplementary books is based on the use of a systems approach to the basic components of learning design which includes analysis of design development, implementation, and evaluation.

The Identification of Learning Objectives

This stage was performed by determining what abilities students must maintain after completing learning. There are 2 stages in carrying out the learning objectives, namely curriculum and student difficulties in learning (Bawa et al., 2014; Harijanto, 2007 and Afrida et al, 2014)

Conducting Learning Analysis

The purpose of learning analytics is to distinguish the knowledge or skills students need to master. Analysis of learning on general learning goals can be accomplished in two ways: the conceiving intellectual or cognitive skills and the forming of goals or strategies.

Students Analysis and Contexts

The analysis of students is in the form of interviews and observations, while the analysis of contexts is in the form of education resources used during the learning process.

The Formulation of Specific Learning Objectives

This refers to the results of the learning analysis and statements about students' initial behavior which will then be formulated with specific statements about what should be done after completing learning.

The Development of Research Instruments

The assessment instruments that have been developed are then linked to the learning objectives of the cognitive domain so that the instruments are made in the form of tests. The test used during the learning process is in the form of essays.

The Development of Learning Strategies

After learning material is collected, a learning program will be designed by determining the strategies that will be used in the learning.

The Development and Selection of Learning Sources

The development of learning resources is in the form of a chemical supplement book on natural ingredients concerning the Genus *Premna* as a source of antimicrobial metabolites. The physical form of the developed book contains preface, table of contents, torso divided into chapters or sections, bibliography, and glossary (Kemenristekdikti, 2016).

The Design and Development of Formative Evaluation

Formative evaluation that can be applied to develop a supplement book draft as follows: 1) review by a team of media experts and material specialists. The results of input from media experts and material specialists would be improved before being utilized for individual trials; 2) individual trials were conducted on 6 students from three categories of learning achievement (high, medium, and low), each of two program users to obtain input on the errors seen in the supplementary books, to receive initial instructions for use, and student reactions on the contents of the supplementary books (Harjanto M., 2007). 3) small group trials were administered on nine students from three categories of learning achievement (high, medium, and low) of three people each to determine the effectiveness of the changes made

after individual evaluation and identify possible problems that still existed (Harjanto M., 2007). Student responses were in the form of questionnaires on student responses which were then carried out by group practice questions. The results of data from supplementary book products, filling in questionnaires and the results of group exercise tests were applied to develop the product. Small group trials conducted on students used a one-shot case study design. This design takes the form of one group given treatment and then observes the process and its results (Sugiyono, 2015).

X O

X = product treatment.

O = process observation and result.

Product Revision

The final step in the process of developing a supplement book is to revise the evaluation carried out by material experts, media specialists, individual trials, and small groups. The data obtained from the formative evaluation were summarized and interpreted to discover the shortcomings of the draft supplementary Chemistry of Nature Materials books regarding the *Premna* Genus plant as an antimicrobial.

Technique and Tools of Data Collecting

According to Sugiyono (2015), data collection can be accomplished in various settings, sources, and methods. The techniques and tools of data collection in this research are as follows:

Indirect Communication Techniques

The indirect communication technique employed was a questionnaire to determine the practicality of chemical supplement books regarding natural ingredients in the genus *Premna* as a source of antimicrobial metabolites. The instrument used in this study was the response questionnaire of lecturers and students. Furthermore, the questionnaire used in this study was in the form of a Likert scale with a number of 5 answer choices according to Riduwan (2013).

Direct Communication Techniques

This direct communication technique was in the form of interviews which were conducted in identifying learning objectives as well as analyzing student characteristics, student analysis, and contexts. The interview served to obtain information on the identification and implementation of learning strategies.

Direct Observation

The direct observation technique in this study utilized an observation sheet instrument carried out in the sixth stage of development learning strategies and the eighth stage of formative evaluation design.

Measurement Technique

This measurement technique was used to determine the learning outcomes of students who enroll in the fifth stage of development learning strategies in the assessment component. The instruments used were practice questions carried out in small group trials.

Data Analysis

The Validity Analysis of Supplementary Books

The validity of supplementary books was obtained from the material assessment of material experts and media specialists using a validation sheet. The material expert assessment consisted of components of content feasibility, presentation feasibility, and language use. Evaluation by media specialists assessed aspects of graphics and presentation. Data that had been collected from all validators in the material and media with the formula used in the calculation to obtain the following percentage:

$$P = \frac{f}{N} \times 100 \%$$

Information:

- f = the number of scores resulting from data collection
- N = maximum score
- P = validity percentage

This was calculated and coordinated with the average percentage validity of the material and media with the percentage of validity criteria according to Akbar (2013).

The Practicality Analysis of Supplementary Book

The practicality of supplementary books is obtained from the response questionnaire assessment data of lecturers who teach Natural Material Chemistry courses and student response questionnaires. The lecturer and student response questionnaire assessment consisted of aspects of material feasibility, language, presentation, graphics, and efficiency provided to be used as a trial sample. The results of the students' and the

Table 1. The percentage of validity criteria.

Percentage	Validity Criteria	Validity Rate
81,00 – 100,00	Very Valid	Can be used without revision
61,00 – 80,99	Valid	Can be used with revision
41,00 – 60,99	Considerably Valid	Major revision is needed
21,00 – 40,99	Less Valid	It is suggested not to be used since it requires major revision
00,00 – 20,99	Not Valid	Cannot be used

Table 2. The questionnaire percentage criteria.

Percentage	Criteria
81-100	Very Practical
61-80,99	Practical
41-60,99	Considerably Practical
22-40,99	Less Practical
0-21,99	Very Impractical

lecturers' response questionnaire were then collected and calculated for the value of each indicator with the formula used in the calculation to obtain the following percentages (Sudijono, 2007):

$$P = \frac{f}{N} \times 100 \%$$

Information :

P = the answer percentage

f = the respondents' answer frequency

N = total of respondents

This was calculated and coordinated the average percentage of student response questionnaires and with the percentage of questionnaire criteria according to Riduwan (2013).

FINDINGS AND DISCUSSION

The results of the development research in this study are supplementary books on Natural Chemistry in the genus *Premna* as a source of antimicrobial secondary metabolites with the development model Dick & Car-

ey (2015) which aims to develop the valid, practical and effective natural chemical supplementary book. Subsequently, in detail, the procedure for developing Dick & Carey according to Pambudiono et al., 2016; Harijanto, 2007 and Puspitasari et al, 2016 as follows:

Identifying Learning Objectives

This stage was accomplished by determining what abilities students need to possess after completing learning. The results of the curriculum review and practical experience were expected to be achieved by the students in their learning objectives after utilizing the Natural Chemistry supplement book about the *Premna* Genus plant as an antimicrobial.

Conducting Learning Analysis

The learning process that was carried out begins with opening greetings, checking the presence of students to find out if there are students who are late in class, giving

Table 3. The capability identification based on learning objectives.

No	Learning Objectives	The Abilities / Component Indicators
1.	Students can explain the potential of secondary metabolites in the <i>Premna serratifolia</i> Plant as an antimicrobial.	Explain secondary metabolites on <i>Premna serratifolia</i> . Explain how to extract. Explain antimicrobial activity in <i>Premna serratifolia</i> .
2.	Students can describe the potential of secondary metabolites in <i>Premna odorata</i> plants as antimicrobials.	Describe secondary metabolites in <i>Premna odorata</i> . Explain how to extract. Define antimicrobial activity in <i>Premna odorata</i> .
3.	Students can recognize the potential of secondary metabolites in the herbaceous <i>Premna</i> Plant as an antimicrobial.	Explain secondary metabolites in <i>Premna herbacea</i> . Describe how to extract. Explicate antimicrobial activity in <i>Premna herbacea</i> .

apperception and motivation, reading supplementary books when the material was presented and then given group assignments. Furthermore, the lecturer concluded the learning material which has been studied, presented a question of evaluation, then closed the lesson.

The Analysis of Learning and Contexts

From the analysis outcomes of the students' characters in the lectures on Natural Chemistry, the researcher perceived that lectures were conducted with discussions, presentations, and assignments. Students had a high motivation to scrutinize the material concerning Natural Chemistry. This can be observed from the activity during the discussion as well as the question and answer session.

On the other hand, from the context analysis results, information was obtained that the learning resources as material for discussion

(especially material about the genus *Premna* as an antimicrobial) were considered to be lacking. This is because learning resources about the material were still unmanageable to be obtained, hence students only relied on learning resources from scientific articles and academic journals concerned from the internet.

The Formulation of Specific Learning Objectives

The expected students abilities based on learning objectives in Table 3.

The Development of Research Instruments

The assessment instrument was in the form of practice questions, particularly the essay questions which were given after the learning process. The practice questions were developed with reference to learning objectives and indicators that had been developed beforehand.

Table 4. The indicators of learning achievement.

The Indicators	Aspect
Explain the potential of antimicrobial secondary metabolites in the <i>Premna serratifolia</i> plants.	C2
Explain the potential of antimicrobial secondary metabolites in the <i>Premna odorata</i> plants.	C2
Explain the potential of antimicrobial secondary metabolites in <i>Premna herbaceae</i> plants.	C2

Table 5. The material contents of developed supplementary book.

Chapter	Material
1	Genus <i>Premna</i> Plant
2	Anti-bacterial
3	Anti-fungal
4	<i>Premna serratifolia</i>
5	<i>Premna odorata</i>
7	The Antimicrobe Prospect of Genus <i>Premna</i>

The Development of Learning Strategy

According to Bawa et al (2014), Harijanto (2007) and Afrida et al (2014), in the development of learning strategies there are several components as follows:

Providing motivation to students and informing learning goals.

The lecturer was obliged to explain the material in accordance with the learning objectives. The material taught was the consequences of microbial growth, treatment of microbial-causing diseases, plants that protected as antimicrobials, plant extraction, secondary metabolite contents, and potential plants for genus *Premna* (*Premna serratifolia*, *Premna odorata*, and *Premna herbaceae*). Exercises were in the form of questions discussed in groups. Each group discussed how to conduct antimicrobial tests on *Premna serratifolia*, *Premna odorata*, and *Premna herbaceae*.

The assessment was performed by correcting the answers to the practice questions that were done by the group.

Follow-up activities were then carried out by studying at and reviewing strategies that have been addressed in a comprehensive manner. This activity was carried out by discussing the results of investigations by observers and lecturers.

The Development and Selection of Learning Materials

In general, developed textbook contains material as presented in Table 5.

The Design and Development of Formative Evaluation

The results of product trials in the form of supplement books were assessed quantitatively and then grouped into three segments, particularly the review by material experts and media specialists, individual trials and experiments in small groups.

Review by team of experts

Review by the first expert team was carried out by material specialists. This assessment was based on aspects of content eligibility, presentation feasibility, and language use. The average percentage of the validity assessment of material experts based on the aspect of content eligibility was 99%, the feasibility of presentation was 98.8%, and the use of language was 100%. This 100% percentage was incorporated into the very valid criteria. The recapitulation of suggestions from material specialists is as follows: 1) in textbooks, it should not be converged on just one plant. It would be trivial if it focused on one genus by changing the title to "Genus *Premna* Plant as Antimicrobial". The reason why preferring this plant was that it is cultivated while other plants live wild; 2) indicators and learning objectives were required in each chapter; 3) practice questions at the end of each chapter were required. 4) in the introductory and chapter sections, the same words were reduced; 5) note the space between each paragraph; 6) the contents of the chapter in the book must be adjusted to the indicators and learning objectives; 7) writing *Premna* cannot be abbreviated; 8) parts of chapters to sub-chapters were numbered so that they were more distinct. 9) tables and classifications of each plant were given 1 space.

Review by the second expert team was carried out by media specialists. This assessment was based on graphics and the feasibility of the presentation. The results of the validity assessment of media experts

based on graphics were 80%. On the other hand, the percentage of presentation eligibility is 80% which was included in the valid criteria. The recapitulation of suggestions from media experts is as follows: 1) the concept of writing was considered good, but the layout must be consistently adjusted to the size of the book; 2) the use of fonts, colors, and images on the front and back covers must be clear and could be interpreted with the correct image title; 3) in the Illustration of contents, an explanation of the type of book, discussion, and advantages of the book were necessitated; 4) in terms of writing ethics, it was essential to check spelling, grammar, and layout content; 5) on the back cover, it was crucial to give a content summary of the book or the biodata of the author. 6) the writings on the front and back covers should be reduced in size; 8) the specifications of the book, type of book, and the number of pages in the layout need to be set according to the number of book pages. 9) the color of the cover, text, image, icon, placement, and other illustrations must meet the center point.

Individual Trials

Individual trials were conducted on 6 students. The learning process commenced with an opening greeting, checking the presence of students to find out whether there were students who came late in the class, giving apperception and motivation, reading supplementary books when the material was presented and providing group assignments to be presented. Furthermore, this test was also included in arranging learning

material, addressing evaluation questions, and then closing the lesson. After this learning was completed, students were requested to fill out a response questionnaire. From the aspect of material feasibility, language, presentation, graphics, and average efficiency, the percentage of 84.51% which was included in the very practical criteria. The recapitulation of suggestions from individual trials was improved wording, correcting grammar and checking the spelling. In addition, the paper margin needed to be reduced to 3 cm for the left. On the other hand, on the right, top and bottom it is necessary to reduce the paper margins to 2 cm each. The font of the contents of the book must also be reduced by 11 cm and added color to the writing of each chapter as well as more precise pictures of the structure.

Small Group Trials

Small group trials were conducted on 9 students. The learning process was carried out by greeting, checking the presence of students whether there are students who are late, giving apperception and motivation, reading supplementary books when the material was presented, giving group assignments, and concluding the learning material. The lesson that day was then closed by greeting. Then students were proposed to fill out a response questionnaire. In the assessment of the response questionnaire of each student, based on the aspects of material feasibility, language, presentation, graphics, and efficiency the average rating was 86.78% with practical criteria. On the other hand, in the lecturer response questionnaire, the results

of practicality assessment based on material feasibility aspects, language, presentation, graphics and efficiency of the average rating were 66% which included practical criteria. The recapitulation of suggestions from small group trials was that there was still some writing that was spaced incorrectly, which was why the writing needs to be corrected repeatedly. Furthermore, books were considered good, effortless to be read, and interesting.

The Revision of Learning Programs

Product revisions were performed after getting advice and input to improve the content of the Natural Chemistry supplement book. The revision was based on suggestions and comments from material expert validators, media experts, individual trials, and small group trials. Enhancements have been made both in terms of appearance, material content, and writing.

The material composition before and after being revised in the Natural Chemistry supplement book concerning the potential of secondary metabolites of the *Premna* Genus plant as antimicrobial:

The Material after being validated:

CHAPTER 1 Genus *Premna* Plants
CHAPTER II Anti-bacterial
CHAPTER III Anti-fungal
CHAPTER IV *Premna serratifolia*
Linn
CHAPTER V *Premna odorata*
CHAPTER VI *Premna herbacea*
CHAPTER VII The Prospects of
Anti-microbe of Genus *Premna*

(a)

(b)

Figure 1. Cover after being validated: (a) front cover (b) back cover.

CONCLUSION AND SUGGESTION

It is concluded that the supplementary book on Natural Chemistry regarding the genus *Premna* plant as an antimicrobial developed in this study is feasible to use with the following eligibility criteria from the results of validation by material experts and media experts, a percentage of 91.6% (very valid) was obtained in terms of the components of content feasibility, the expediency of presentation, the use of graphical language and presentation using media and material validation sheets. Based on the assessment of the response questionnaire on individual trials, the Practicality of Natural Chemistry Supplementary Books was 84.51%. On the other hand, the percentage of small group trials was 76.39%.

Pertaining to the limitations of this research, it is advised that fur-

ther researchers who desire to conduct additional research to do the students are advised to use the best time possible and not to look for excuses just because of the preparation of the Final Semester Exam and Business Work Lectures administered outside the city of Pontianak. One of the deficiencies of the supplement book developed is material which is only limited to the antimicrobial activity of the *Premna* Genus plant. It is recommended to add other *Premna* Genus plants that have been studied for antimicrobial activity so that these medicinal plants can be applied in the community.

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