

# Development of Android-Based Fundamental Ecology Book

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**Abstract.** In order to optimize the achievement of the learning outcomes in the fundamental ecology course, the presence of a digital fundamental ecology book based on android technology is greatly needed. This developmental research uses the Thiagarajan model modification, with the stages of define, design and develop. The research subjects is content/material expert, digital media expert, lecturers and students participating in the course. The research instrument used questionnaire in the form of a validation sheet. The e-book content is introductory ecology, organisms and its environment, animal and plant populations, animal and plant communities, living things interactions, ecological succession, biogeochemical cycles, ecosystems, and vegetation analysis. The validation results showed that the developed digital android-based fundamental ecology has achieved very feasible qualifications, as indicated by both content/material expert (93.75%) and digital media expert (86.11%). The responses of the fundamental ecology lecturers were very decent (89.47%) and student responses were good (84.56%).

**Keywords:** basic ecology; e-book; android

## 1 Introduction

The fundamental ecology course is compulsory in the Biology Department, FMIPA, State University of Medan (UNIMED), both for biology education students (DIK) and biology students (Non DIK). The fundamental ecology course is part of the ecology KDBK and has three credits. The lectures are conducted in theory in the class and practice in the laboratory or the field.

The content of fundamental ecology course in short description at biology department of FMIPA Unimed is the interactions that determine the abundance and distribution of plants and animals in various ecosystems in Indonesia, particularly in North Sumatra. The topics covers ecology introduction, limiting factors for plants and animals in a habitat or ecosystem, plant and animal populations, plant and animal communities, organism interactions, changes in plant and animal

communities (succession), biogeochemical cycles, various types of ecosystems in Indonesia and ecological research methods <sup>[1]</sup>.

In the fundamental ecology learning process, before the covid 2019 era, the learning resources that be used by students was in text books form, but now since covid or corona era, the learning process mainly has been done in online format, and therefore the learning resources in digital form is greatly needed. In addition, in learning process at present, the information that be needed by students are predominantly be supplied by digital media through the using of their mobile phones.

In this regard, alongside the rapid development and utilization of information technology for various purposes, including the widespread use of android smartphones among students, there is a pressing need for innovation in the availability of learning resources in higher education. Specifically, the introduction of android-based digital learning resources for fundamental ecology is anticipated by students and lecturers. The application of digital android-based teaching materials offers students greater ease and flexibility in learning fundamental ecology course, free from the constraints of time and place. In other words, the availability of these digital resources can facilitate students in achieving the learning outcomes for the fundamental ecology course and potentially increase their interest and motivation to learn. This also implies an enhancement in the interaction between lecturers and students during the teaching and learning process, whether in the classroom, the laboratory, or in the field.

Some research results have shown that the using of android-based digital teaching materials in learning process can enhance the learning effectiveness and significantly can improve the student achievement <sup>[2, 3, 4, 5, 6]</sup>.

Until now, there is no android-based digital teaching materials that available for fundamental ecology course at biology department-FMIPA-Universitas Negeri Medan (Unimed) and its availability also there is no in the digital market. Therefore, to improve the interaction between lecturers and students in fundamental ecology course, and especially in order to optimize the achievement of the its course learning outcomes (CPMK) by students, a developmental research with the titled "Development of Android-Based Fundamental Ecology Book" has been done.

## **2 Method**

This research was conducted at the biology department, Faculty of Mathematics and Natural Sciences (FMIPA), State University of Medan, located at Jalan William Iskandar Pasar V, Postal Code 20221 and took place from February to August 2024.

This research is development research with the subjects of content/material expert, digital media expert, fundamental ecology lecturers and students participating in fundamental ecology courses, while the object is the android-based digital fundamental ecology book that be developed.

This development research follows the procedure of Thiagarajan model modification with the stages of define, design and develop <sup>[7, 8]</sup>. At the define stage, several analyses are carried out, namely needs analysis, curriculum analysis, ecology text book analysis and analysis of course learning outcomes (CPMK). In the design stage, the selecting materials for fundamental ecology

was carried out and also the format selection. In the format selection process, an outline or framework for Android-based fundamental ecology book was created by using the android studio application and android emulator <sup>[9, 10]</sup>. Furthermore, in the develop stage, the teaching materials were validated or responses by material/content expert, digital media expert, fundamental ecology lecturer and students (in individual, small group, and large group tests).

The research instrument used questionnaires <sup>[11, 12]</sup>. The content/material expert's questionnaire assesses content and language feasibility with 15 indicators, while the digital media expert's questionnaire evaluates presentation, effectiveness, and graphics also consist of 15 indicators. Course lecturers' responses consist of formulation of learning objectives, feasibility of presentation, effectiveness, and graphics with 16 indicators. Students participating in the course provide feedback based on 12 indicators. The Likert scale of 1-4 (4: very feasible; 3: feasible; 2: less feasible; 1: not feasible) is used for expert and course lecturers, while students use a scale of 1 (good) and 0 (not good). The data analysis of expert validation, lecturer and student responses refers into the following justification (Table 1-3).

**Table 1.** Justification for content and digital media experts validation

| Score               | Percentage Interval        | Validator Criteria |
|---------------------|----------------------------|--------------------|
| $15 \leq x \leq 26$ | $25\% \leq x \leq 43.75\%$ | not feasible       |
| $26 < x \leq 37$    | $43.75\% < x \leq 43.75\%$ | less feasible      |
| $37 < x \leq 48$    | $62.5\% < x \leq 81.25\%$  | feasible           |
| $48 < x \leq 60$    | $81.25\% < x \leq 100\%$   | very feasible      |

**Table 2.** Justification for lecturer responses

| Score               | Percentage Interval        | Response Criteria |
|---------------------|----------------------------|-------------------|
| $16 \leq x \leq 28$ | $25\% \leq x \leq 43.75\%$ | not feasible      |
| $28 < x \leq 40$    | $43.75\% < x \leq 62.5\%$  | less feasible     |
| $40 < x \leq 52$    | $62.5\% < x \leq 81.25\%$  | feasible          |
| $52 < x \leq 64$    | $81.25\% < x \leq 100\%$   | very feasible     |

**Table 3.** Student responses to teaching materials

| Score             | Percentage Interval    | Response Criteria |
|-------------------|------------------------|-------------------|
| $0 \leq x \leq 6$ | $0\% \leq x \leq 50\%$ | not good          |
| $6 < x \leq 12$   | $50\% < x \leq 100\%$  | good              |

### 3 Results and Discussion

The following results and discussion are based on research development stages according to Thiagarajan's model (define, design and develop stages):

### **3.1 Define stage**

Based on curriculum analysis and literature study that be conducted on various ecology textbook that be written by some authors <sup>[13, 14, 15, 16, 17, 18]</sup> and also by documentation study on semester course planning (RPS) of fundamental ecology course at the biology department of State University of Medan, could be defined the scope and student achievement after the following of fundamental ecology course. In this case, its aims or goals are students able: To comprehend the basic concept, scope and objectives of plant and animal ecology, to analyze organisms and their environment with study limiting factors (abiotic and biotic) that limit the diversity, abundance and distribution of plants and animals in a habitat/ecosystem, to analyze plant and animal populations and communities, to provide examples of various types of interactions that occur between plants and animals, to understand interactions between plants and animals, to comprehend aspects of plant and animal community changes (succession), to analyze biogeochemical cycles and to understand various types of ecosystems, especially in tropical areas (Indonesia, in particular).

### **3.2 Design stage**

Based on the scope and learning outcome of fundamental ecology course that be mentioned above, the content design of the android digital-based fundamental ecology book includes:

Cover

Chapter I: Ecology introduction

Chapter II: Organisms in complex environments

Chapter III: Plant and animal populations

Chapter IV: Plant and animal communities

Chapter V: Organism interactions

Chapter VI: Ecological succession

Chapter VII: Biogeochemical cycles and ecosystems

Chapter VIII: Vegetation analysis

Bibliography

Glossary

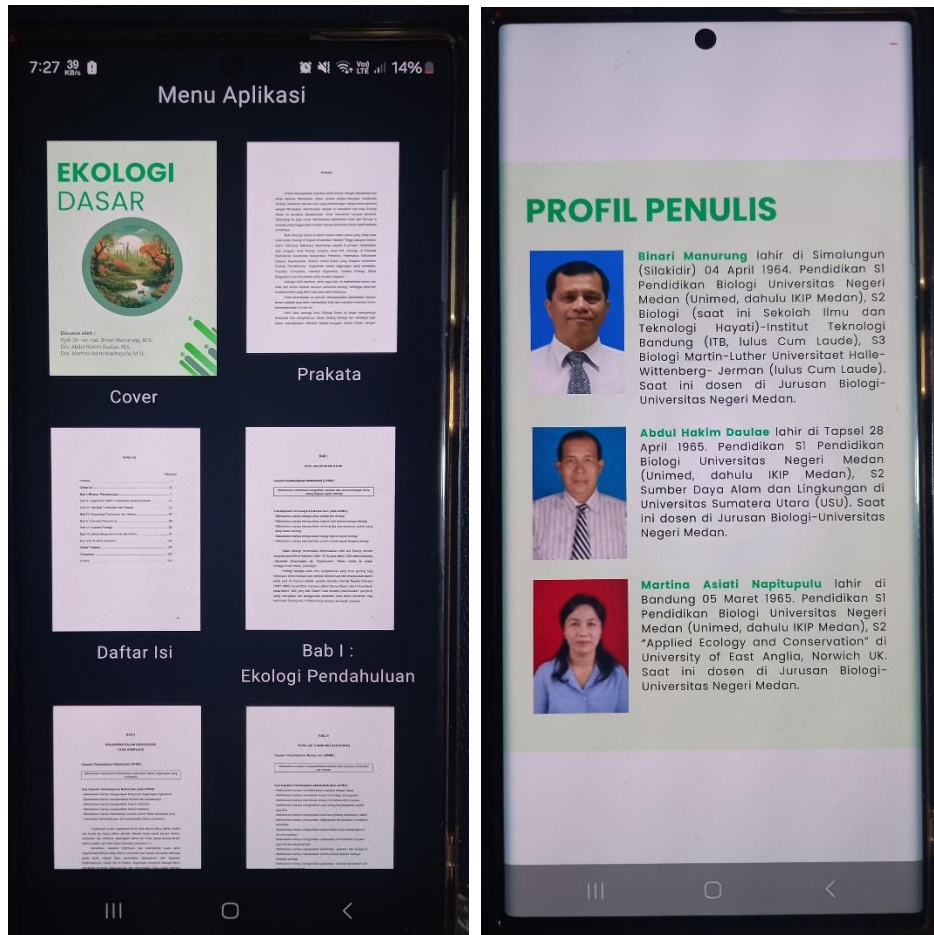
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### **3.3 Development stage**

At the development stage, the teaching materials that be created according to the design outlined be continued with the validation by. content expert, digital media expert and response tests of course lecturers and students who have taken the fundamental ecology course. The appearance

(a part) of the android-based digital fundamental ecology book that was developed is as displayed in Fig. 1.



**Fig. 1.** Cover, foreword, table of content, ecology introduction and authors biography of Ekologi Dasar (Fundamental ecology)

Based on the validation that be conducted by content or material expert, the android-based digital fundamental ecology book that be developed was rated as "very feasible" (93.75%). This indicates that the fundamental ecology e-book that be developed is ready for use in the class to support the fundamental ecology learning process. Concerning the content, the content expert suggested that examples that be provided in the teaching materials should be drawn from the students' environment in order to avoid the verbalism. When considering the main indicators, both in terms of content suitability (eight indicators) and language (four indicators), the developed teaching materials received "very feasible" ratings. These high validation results,

according to content expert, are because the content of the developed e-fundamental ecology aligns with the content of existing ecology textbooks that available in the market, such as written by well known ecology authors <sup>[13-18]</sup>.

The validation of the e-book developed from the perspective of android-based digital media expert was also very feasible (86.11%). This very feasible criteria indicates that the teaching materials are highly suitable for supporting the learning process in classroom and at out classroom. Based on presentation aspect (six indicators), effectiveness (three indicators) and graphics (six indicators) are very feasible with 87.50%, 83.33% and 87.50%, respectively. According to digital media expert, the android-based fundamental ecology that be developed was very feasible because the e-book meets the criteria for appearance, programming and content/material <sup>[19]</sup>.

Based on feedback that came from the fundamental ecology lectures, in this case be based on 16 indicators that be grouped into four main categories (CPMK and Sub CPMK formulation, presentation, effectiveness, and graphics), the e-book that be developed was "very feasible" (89.47%). Furthermore, the analysis for four main aspects showed that e-book that be developed was very feasible. In this case, the score for formulation of CPMK and sub CPMK (four indicators), presentation (five indicators), effectiveness (three indicators) and graphics (four indicators) were 93.75%, 85.00%, 91,66% and 87.50 %, respectively. This high feasibility was because its content was in line with learning outcomes of fundamental ecology course. Ningsih (2019) <sup>[20]</sup> stated that a learning resource or media is considered valid or appropriate if it meets predetermined criteria, especially in material or content aspects.

The response of students who recently completed the fundamental ecology course into e-book fundamental ecology that be developed were good (84.56% from 39 students as respondent) and sufficiently engaging for using in the teaching and learning process of fundamental ecology. The detailed results for each test are as follows: the individual test (three participants) rated it as good (86.11%); the small group test (nine participants) rated it as good (84.25%), and the large group test (27 participants) rated it as good also (83.33%). The favourable evaluation of the developed digital android-based fundamental ecology from the students' perspective are because the e-book adheres to the indicators covered in the content, IT media and learning objectives (CPMK/sub CPMK). Arikunto (2019) <sup>[20]</sup> stated that a learning resource, including books, is considered feasible or valid if it achieves a score above 61%. In this case, the developed digital Android-based Basic Ecology book has a score exceeding 80%.

## **4 Conclusion**

The android-based fundamental ecology that be developed is very feasible (valid) by content/material expert, digital media expert, and course lecturer responses and good according to the students. Therefore, this e-book is feasible to be used in the fundamental ecology learning process.

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## References

- [1] Manurung, B. 2023. Rencana Pembelajaran Semester (RPS) Ekologi Dasar. Medan: Program Studi Biologi dan Pendidikan Biologi-FMIPA Universitas Negeri Medan.
- [2] Muyaroah, S & Mega Fajarita. 2017. Pengembangan Media Pembelajaran Berbasis Android dengan Menggunakan Adobe Flash CS 6 pada mata pelajaran biologi. *Mata Technology*, 6(2): 79-83.
- [3] Sari, W.P & Ma'rifah, D.R. 2020. Pengembangan LKPD Mobile Learning Berbasis Android Dengan PBL Untuk Meningkatkan Critical Thinking Materi Lingkungan. *Jurnal Pendidikan Biologi* 11 (2): 49-58.
- [4] Isnaeni, W., Sujatmiko, Y. A., & Pujiasih, P. 2021. Analysis of The Role of Android-Based Learning Media in Learning Critical Thinking Skills and Scientific Attitude. *Jurnal Pendidikan IPA Indonesia*, 10(4): 607-617.
- [5] Nofitasari, A., Lisdiana, & Marianti, A. 2021. Development of My Biology App Learning Media Based on Android Materials of Food Disgestion Systems as Student Learning Source at Senior High School. *Journal of Innovative Science Education*, 10 (1): 70-78.
- [6] Susanto, L H., Rostikawati, RT., Novira, R., Sa'diyah, R., Istikomah., & Ichsan I. 2022. Development of Biology Learning Media Based on Android to Improve Students Understanding. *Jurnal Penelitian Pendidikan IPA*, 8 (2): 541-547.
- [7] Sugiyono. 2019. *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfabeta.
- [8] Thiagarajan, S., Semmel, D. S., & Semmel, M. I. 1974. *Intructional Development for Training of Expectional Children*. Minneapolis, Minnesota: Leadership Training Institute/Special Education, University of Minnesota.
- [9] Nazruddin, N. S. 2012. “Android: Pemrograman Aplikasi Mobile Smartphone dan Tablet PC Berbasis Android.” Bandung: Informatika.
- [10] Darmawan, D. 2016. *Mobile Learning Sebuah Aplikasi Teknologi Pembelajaran*. Jakarta: Rajawali Press.
- [11] Sanusi, S. Suprpto E., & Apriandi, D. 2015. Pengembangan Multimedia Interaktif Sebagai Media Pembelajaran Pada Pokok Bahasan Dimensi Tiga di Sekolah Menengah Atas (SMA). *JIPM (Jurnal Ilmiah Pendidikan Matematika)*, 3 (2): 398-416.
- [12] Maulana, R. 2017. Pengembangan Mobile Learning (M-Learning) Berbasis Android Dalam Pembelajaran Biologi Pada Materi Struktur dan Fungsi Sel Penyusun Jaringan Tumbuhan dan Hewan Kelas XI SMA/MA. Skripsi, Universitas Islam Negeri Raden Intan Lampung.
- [13] Kendeigh, S.C. 1980. *Ecological with Special Reference to Animals and Man*. New-Delhi: Prentice-Hall.
- [14] Emberlin, J.C. 1983. *Introduction to ecology*. Estover, Plymouth: Macdonald & Evans Ltd.
- [15] Odum, E.P. 1983. *Basic Ecology*. W.B. Saunders Company.

- [16] Krebs, C.J. 1984. Ecology: The Experimental Analysis of Distribution and Abundance. New York: Harper and Row Publishers.
- [17] Barbour, M.G., J.H. Bark and W.D. Pitts. 1987. Terrestrial Plant Ecology. California: Benjamin/Cumming Publishing Co.
- [18] Begon, M., Harper; J.L & C.R. Townsend.1990. Ecology: Individual, Population and Communities. Oxford: Blackwell Scientific Publications.
- [19] Ningsih, S. 2019. Persepsi Mahasiswa Terhadap Mobile learning berbasis Android. Pedagogia Jurnal Ilmu Pendidikan 17 (1): 45-54.
- [20] Arikunto, S. 2019. Prosedur Penelitian Suatu Pendekatan Praktik. Jakarta: Rineka Cipta.