DEVELOPMENT OF AN *ARGUMENT-DRIVEN INQUIRY (ADI)*-BASED SCIENCE E-BOOK ON ECOLOGY MATERIALS

Intan Lestari [1*], Ismail Fikri Natadiwijaya [2]

[1.2] *Science Education Study Program, Yogyakarta State University, Yogyakarta, Indonesia*

[*] Corresponding Author: *intanlestari.2023@student.uny.ac.id*

Abstract: The development of technology in the 21st-century has brought significant changes in the world of education, including the need for more interactive and contextual learning media. One of the challenges in science learning at the junior high school level is the preservation of complex and abstract ecological materials. This research aims to develop an *Argument-Driven Inquiry* (ADI)-based science e-book on ecological materials as an innovative solution to improve students' understanding of scientific argumentation concepts and skills. The research method used is *Research and Development* (R&D) with a 4D model (*define*, *design, develop, and disseminate*) without disseminate stages. The products were validated by material experts and media experts, and tested for practicality by science teachers and junior high school students. The results of the study show that this e-book meets the criteria of "Very Feasible" in terms of content, presentation, language, and visual appearance. The practicality test also showed the "Very Practical" category with a percentage of 71.42%–100%. These findings show that ecological ADI-based science e-book are feasible and practical to use as an interactive medium that supports inquiry approaches and 21st-century skill development in learning.

Keywords: *argument-driven inquiry, e-book, ecology, science learning*

INTRODUCTION

In the 21st-century era, technology is developing so rapidly and bringing significant transformations in the world of education, including science learning at the junior high school level (UNESCO, 2021). The development of technology in the modern era has a significant impact on changes in the order of life, especially in the field of education (Faiz et al., 2020:52). Science is one of the materials taught at the junior high school level. The study of relationships between living organisms and their environment forms the core of ecology in science education (Kemendikbud, 2022). This material is often considered abstract by learners because it covers complex concepts such as food chains, energy flows, and ecosystem dynamics (Driver et al., 1994). This challenge is exacerbated by the limitations of conventional learning media (printed book) that are less interactive in presenting dynamic ecological phenomena (Mayer, 2009).

Therefore, the importance of using technology through digital learning media such as e-book is an innovative solution to visualize ecological concepts in a more real and interesting way (Hwang et al., 2020). Science learning provides a real opportunity for students to observe and imagine the use of learning tools and media from the surrounding environment. Through science learning, it is hoped that students will be able to provide knowledge and research phenomena in daily life (Wedyawati & Lisa, 2019:30). E-book are a learning tool that is very suitable for use as a learning medium in today's modern era, which contains materials, questions, and evaluations to achieve educational goals electronically (Halim, et al., 2023).

The ability of students to utilize electronic devices encourages the creation of new innovations such as learning media that support the learning process both in the classroom and when reviewing material that has been learned at home (Faiz, 2021:131). Nizar et al. (2022) stated that e-books can significantly influence the younger generation-a tech-savvy and independent-thinking demographic. As a modern learning tool, e-book are highly suitable for contemporary education, offering integrated materials, exercises, and digital assessments to achieve educational objectives (Halim et al., 2023).

E-Book not only present static text and images, but can also integrate multimedia elements such as videos, animations, and interactive simulations of ecosystem processes (Lestari, R. T., & Adi, E. P. (2018). These features allow junior high school students to explore ecological material independently and contextually, for example through simulation of the impact of pollution on the food chain or visualization of biogeochemical cycles (Schugar, Smith, & Schugar, 2013). Using alternative media in the learning process is by utilizing technology to develop teaching materials in digital formats, such as e-book. E-book are generally digital versions of books that come in formats, utilizing electronic elements to present information in various forms, such as text, graphics, images, and videos. E-Book is an electronic or digital learning medium that can be accessed using the appropriate hardware and software to read e-book (Vassiliou & Rowley, 2008).

The *Argument-Driven Inquiry* (ADI) learning model is particularly suitable for ecological materials because it emphasizes the development of evidence-based scientific arguments. For example, students can be invited to analyze real cases such as the impact of deforestation on biodiversity, then design investigations, collect data, and formulate arguments based on findings (Sampson et al., 2010). ADI also encourages collaboration through peer review, where students evaluate each other's investigative reports on ecological issues such as global warming or eutrophication (Mutia, 2015). This approach not only enhances conceptual understanding but also trains 21st-century skills such as critical thinking and scientific communication (Erika & Prahani, 2017).

One of the right learning models to use is the *Argument-Driven Inquiry* (ADI)-based learning model. This model is a form of inquiry-based learning that

emphasizes the process of drafting and testing arguments. ADI is designed so that students can design their own methods in collecting data, conducting experiments, answering questions, writing, and reflecting on the learning process (Manurung et al., 2020).

The ADI model provides opportunities for students to develop scientific argumentation skills in science learning (Sampson et al., 2010) as well as encourage them to write and think reflectively. In addition, students are also invited to be involved in the argumentation and peer review process (Walker in Mutia, 2015). ADI has been proven to be able to improve students' argumentative skills (Erika & Prahani, 2017). The ADI learning process consists of eight stages: formulating assignments and questions, collecting data, making initial arguments, participating in argumentation sessions, conducting reflective discussions, compiling investigative reports, conducting anonymous peer review, and revising reports (Mutia, 2015). This model increases learner engagement because it encourages them to connect ideas with evidence as well as convey arguments effectively (Andriani et al., 2015).

Based on the description above, the formulation of the problem in this study includes the feasibility of the Science e-book based *on Argument-Driven Inquiry* (ADI) and how practical it is according to science teachers and students in science learning. The purpose of this study is to produce a science e-book based on *Argument-Driven Inquiry* (ADI) that is considered feasible by media experts and subject matter experts, as well as practical according to science teachers and students.

METHOD

This research is a *Research and Development* (R&D) research. The type of research uses the 4-D development model according to Thiagarajan (1974), which includes the stages *of define, design, develop*, and *disseminate*. However, in this study, it was only used up to the development stage without involving the *disseminate stage*.

This *define* stage aims to be carried out for initial analysis which includes student analysis, task analysis and concept analysis. The *design stage* is carried out with the aim of designing an initial product in the form of an e-book that will be developed based on data obtained from the initial design stage. This design stage consists of 4 stages, namely test preparation, media selection, format selection, and initial design. The final result of this stage is the initial design (prototype) of the e-book. The *develop* stage is the product realization stage. This development stage aims to produce *a revised e-book* that is worthy of development.

This research was conducted at the Department of Science Education, FMIPA UNY and the trial was limited to subjects consisting of 10 research students conducted at SMP Negeri 4 Yogyakarta in April-May 2025. The data collection

instruments used in the development of this ADI-based science e-book are feasibility instruments by validators and practicality by science teachers and students. This validation is intended to make the products developed feasible and practical. The data analysis technique from the response sheet is quantitative descriptive data analysis in the form of a score from and categorized based on the likert scale as follows:

Table 1. Categories of Scales in the Likert Scale

Score	Information
1	Very Feasible
2	Feasible
3	Less Feasible
4	Not Feasible

(Saifuddin Azwar, 2015)

Table 2. Validation Sheet Analysis

Score Range	Interpretation
Mi + 1.5 SBi < X	Very Feasible
Mi + 0.5 SBi < X ≤ Mi + 1.5 SBi	Feasible
Mi - 0.5 SBi < X ≤ Mi + 0.5 SBi	Moderately Feasible
Mi - 1.5 SBi < X ≤ Mi - 0.5 SBi	Less Feasible
X ≤ Mi - 1.5 SBi	Not Eligible

(Modified from Literary, 2015:73)

Information:
X = Respondent score
Mi = Ideal red
SBi = Ideal Standard Balance
Mi = 1/2 (ideal high value + ideal low value)
SBi = 1/6 (ideal highest value - ideal lowest value)

The data analysis technique from the response sheet is quantitative descriptive data analysis in the form of percentages. The data will be calculated using the Guttman scale and have details as shown in table 3 below:

Table 3. Gutmann scale assessment conditions

Answer	Score
Yes	1
Not	0

(Riduwan, 2016)

Calculation of assessment scores with percentage calculation with the following details.

$$\text{Feasibility Percentage} = \frac{\text{Total score (X)}}{\text{Maximum score } (Xi)} \; x \; 100\%$$

Information:

Total score = total number of scores obtained from respondents
Highest score = maximum score of each question item x number of respondents
Next, it is the integration of the feasibility assessment score with the following provisions:

Table 4. Interpretation of Learner Response Scores

Valuation	Criterion
81%-100%	Very Practical
61%-80%	Practical
41%-60%	Moderately Practical
21%-40%	Not Impractical
0%-20%	Very Impractical

(Riduwan, 2016)

RESULTS AND DISCUSSION

The process of developing teaching materials in the form of e-books contained in this study is guided by the 4D development model.

1. *Define*

   This study's define phase systematically identifies learner needs and product specifications through a multi-stage analysis. According to Thiagarajan et al. (1974) framework, we conducted: (1) initial analysis of classroom challenges, (2) student characteristic assessment, (3) task requirements evaluation, (4) concept mapping, and (5) learning objective formulation. The investigation revealed critical gaps: predominantly teacher-centered instruction (Anwar et al., 2019) and inadequate lab resources (Azwar, 2007) hinder effective science education. Field data shows students demonstrate strong visual media responsiveness but remain disengaged in discussions. These findings necessitate developing an ADI-based interactive e-book featuring multimedia components (videos, simulations) to overcome infrastructure limitations while promoting active learning (Lestari & Adi, 2018; Schugar et al., 2013).

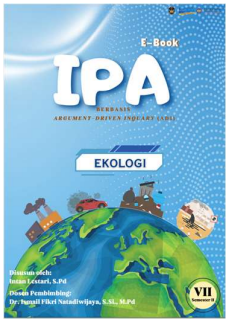
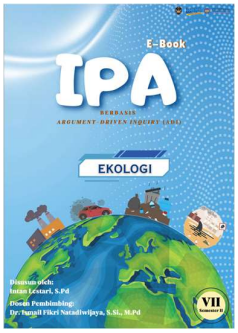
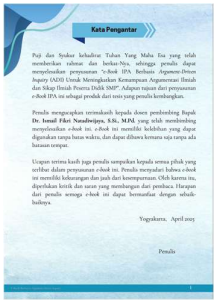
2. *Design*

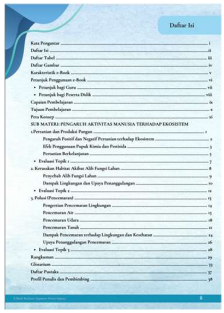
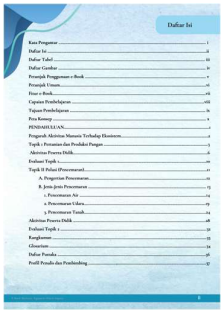
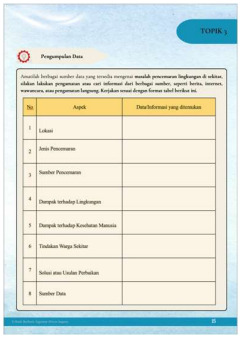
   The *design stage* aims to determine the design of the initial product in the form of an e-book that will be developed based on the data obtained from the initial design stage. Thiagarajan et al. (1974) explained that this stage aims to prepare an initial product design that will be developed systematically. Dick, Carey, & Carey (2005) also added that instructional design must contain delivery strategies, media selection, and learning evaluation designs that are in accordance with the characteristics of students. This design stage consists of 4 stages, namely test preparation, media selection, format selection, and initial design. The final result of this stage is the initial design (prototype) of the e-book.

3. *Development*

The development stage is the product realization stage. The development stage aims to produce *a revised e-book* that is worthy of development. Thiagarajan et al. (1974) stated that the development stage aims to test and improve the product until it is suitable for use. Borg & Gall (2003) emphasized that product trials on a small scale are essential in development research to obtain initial feedback from users. This stage begins with ADI-based *e-book* validation. In the validation process, *draft I* was submitted to one lecturer as a material expert and one media expert lecturer to be validated, then phase 1 revision was carried out. After this phase 1 revision, a *draft II ADI-based e-book* was produced. *Draft* II was then tested on a limited basis. Testing the practicality for science teachers and the readability *of draft* II of the ADI-based e-book was carried out on 10 junior high school students in grade VIII. After the limited trial is completed, phase 2 revision will be carried out until *the e-book* is declared feasible and practical to use.

Table 5. Repair advice and product repair results

Yes	Revision Suggestions	Revised Results
1.	 On the cover, it is suggested that the title "inquary" be corrected to "inquiry")	 After being revised to "*inquiry*"
2.	 In the second paragraph, the thank you should be merged, then the third paragraph in the sentence has	 After the revision of the writing thank you, and the writing in the third paragraph

	many shortcomings that should be reduced	
3.		
	Table of contents in points replaced with numbers or letters	Points are revised using numbers and letters
4.		
	In the topic element section 1 is made middle and only 1 time per page	Topic 1 writing is in the middle and does not repeat on the bottom page
5.		
	At each stage, the data collection section in the *e-book* is made into simple sentences as well as the other stages	The e-book stage "data collection" was replaced with "let's collect data" as well as the next stage

In table 5. Revisions are made to the products that are developed, this stage is carried out to improve the products to be developed. After the revision, a limited

trial will be carried out. The results of the acquisition of media and material expert validation scores are as follows.

Table 6. Results of Material Expert Validation Test

Aspects	Validator Score	Maximum Score	Category
Content eligibility	15	16	Very Feasible
Serving	11	12	Very Feasible
Language	3	4	Very Feasible
Graphics	12	12	Very Feasible

Based on table 6 of the results of the validation of material experts, all aspects that were assessed received the "Very Feasible" category. This shows that the material in terms of content, the material aligns with learning objectives and student needs, supporting Prawiradilaga (2020), Rahmiati & Retnawati (2023) view that content relevance is essential for achieving learning competencies. The presentation is systematic and easy to understand, facilitating meaningful learning (Sungkono, 2021; Heinich et al., 2022). The use of language is clear, age-appropriate, and enhances readability (Sugihartono, 2022; Lestari & Hidayat, 2023). Lastly, the visual design is engaging and supports comprehension, consistent with Mayer's (2021) theory and Astuti et al. (2023) findings that effective visuals improve understanding and student motivation.

Table 7. Media Expert Validation Test Results

Aspects	Validator Score	Maximum Score	Category
Cover	8	8	Very Feasible
Main Menu	15	16	Very Feasible
Instructions for Use	8	8	Very Feasible
Foreword	16	16	Very Feasible
Introduction	8	8	Very Feasible
Fill	8	8	Very Feasible
Cover	8	8	Very Feasible
Language	4	4	Very Feasible
Graphics	8	8	Very Feasible

Based on table 7, the results of the validation of media experts also show that all aspects are rated "Very Feasible", including the cover, main menu, instructions for use, language, and graphics. The cover is visually appealing, creating a positive first impression, in line with the *aesthetic-usability effect* (Norman, 2016). The main menu is user-friendly and accessible, reflecting the principles of *Universal Design for Learning* (CAST, 2018). Clear and concise user instructions support *just-in-time learning* (Huang et al., 2020), allowing users to quickly understand how to operate the media.

The preface and introduction effectively establish context and activate prior knowledge, as recommended by *situated cognition* (Hodges et al., 2020) and *cognitive load theory* (Sweller et al., 2019). The content aligns with the curriculum and integrates technology, pedagogy, and subject matter based on the *TPACK* framework (Mishra, 2020). The closing section encourages learner reflection, supporting the *reflective learning* approach (Ryan & Ryan, 2015). The language is appropriate and accessible for the target audience, aligning with *language accessibility* principles (UNESCO, 2021). Meanwhile, the visual design enhances comprehension by applying *multimedia learning* principles (Mayer, 2021).

The ebook developed has met several assessment criteria from the National Education Standards Agency as stated by Fahrudiin (2020:69), including the suitability of the material with IP, KD, and learning objectives; the presentation of illustrations or examples to facilitate student understanding; the use of simple language that is in accordance with the student's ability level; and the use of clear, non-double-meaning, and interesting sentences so that it can increase reading interest and comprehension students to the material.

The limited trial was conducted at SMPN 4 Yogyakarta. The limited trial was carried out by 2 science teachers as a practical test and 10 students. The results of the practicality test can be seen in tables 8 and 9 below.

Table 8. Results of Practicality Test by Science Teachers

Aspects	Validator Score	Maximum Score	Percentage (%)	Category
Effectiveness	60	60	100	Very Practical
Ease of use	60	60	100	Very Practical
Language	60	60	100	Very Practical
Display	60	60	100	Very Practical
Efficiency	60	60	100	Very Practical

Based on table 8, the results of the practicality test by science teachers show that all aspects (effectiveness, ease of use, language, appearance, and efficiency) obtained a score of 100% with the category of "Very Practical". The ebook developed has also met a number of assessment criteria as stated by Winarno in (Ernawati & Sukardiyono 2017:205), including the suitability of the content with the initial purpose of media development, the existence of supporting information such as instructions for use, attractive display, clear navigation, interactive and enjoyable use, ease of access, and the availability of evaluation and feedback.

Table 9. Results of Readability Test by Students

Aspects	Student Score	Maximum Score	Percentage %	Category
Display	50	70	71,42	Practical
Ease of Use	28	30	93,33	Very Practical
Language	20	20	100,00	Very Practical

Material	20	20	100,00	Very Practical

Based on table 9, the results of the readability test by students show that the category is very practical. This is proven based on the theory of Sugiyono, 2015 which says that even a product is said to be practical if the score is ≥ 75% = Practical, and ≥ 90% = Very Practical. The test results showed that the students found the product easy to use and the language was easy to understand, although there was little room for improvement in the display aspect.

CONCLUSION

Based on the results of the research, the science e-book based on *Argument-Driven Inquiry* (ADI) on ecological materials has proven to be feasible and practical according to the assessment of material experts, media experts, science teachers, and students. This product meets the standards of content, construct, and usability validity with the category "Very Feasible". The practicality test also showed a positive response from teachers and students, especially in terms of ease of use, language, and appearance. Thus, this e-book can be implemented as an innovative learning medium that supports inquiry approaches and the development of 21st-century skills such as critical thinking and collaboration. The recommendation for the next research is to test the effectiveness of e-book in improving students' learning outcomes and argumentation skills.

REFERENCES

Andriani, S., Nurlaelah, I., & Setiawan, W. (2015). Penerapan Model *Argument-Driven Inquiry* untuk Meningkatkan Keterampilan Argumentasi Siswa pada Konsep Pencemaran Lingkungan. *Jurnal Pendidikan IPA Indonesia*, 4(2), 89-94.

Anwar, Y., Susanti, R., & Ermayanti. (2019). Analyzing Scientific Argumentation Skills of Biology Education Students in General Biology Courses. *Journal of Physics: Conference Series*, 1166(012001), 1–5. https://doi.org/10.1088/1742- 6596/1166/1/012001.

Astuti, R., Putri, F. A., & Wulandari, D. (2023). *Desain grafis edukatif: Meningkatkan motivasi belajar siswa melalui visualisasi*. Yogyakarta: Media Edukasi Press.

Azwar, S. (2007). *Metode Penelitian*. Yogyakarta: Pustaka Pelajar.

CAST. (2018). *Universal Design for Learning guidelines version 2.2*. http://udlguidelines.cast.org

Dick, W., Carey, L., & Carey, J. O. (2005). *The systematic design of instruction* (6th ed.). Boston: Pearson.

Driver, R., Newton, P., & Osborne, J. (1994). Establishing the Norms of Scientific Argumentation in Classrooms. *Science Education*, 84(3), 287-312.

Erika, E., & Prahani, B. K. (2017). Model Pembelajaran Argument-Driven Inquiry (ADI) untuk Melatihkan Keterampilan Argumentasi Ilmiah Siswa SMA. *Jurnal Pendidikan Fisika Indonesia*, 13(1), 32-41.

Ernawati, I. dan Sukardiyono, T. (2017). "Uji Kelayakan Media Pembelajaan Interaktif Pada Mata Pelajaran Administrasi Server." Elinvo (*Electronic, Informatics, and Vocational Education*) 2(2):204–10.

Fahruddin. (2020). *Pengembangan bahan ajar berbasis elektronik untuk meningkatkan pemahaman siswa*. Jakarta: Pustaka Edukasi.

Fahrudiin, I. (2020). "Analisis Buku Ajar Sejarah Kebudayaan Islam Menurut Badan Standar Nasional Pendidikan." *At-Tarbawi: Jurnal Kajian Kependidikan Islam* 5(2):65–82.

Faiz, A., Soleh, B., Kurniawaty, I., & Purwati. (2021). Tinjauan analisis kritis terhadap faktor penghambat pendidikan karakter di Indonesia. *Jurnal Basicedu*, 5(4), 1766–1777.

Faiz, A., Purwati, & Kurniawaty, I. (2020). Construction of prosocial empathy values through project based learning methods based on social experiments (Study of discovering cultural themes in the Sumber-Cirebon society). Ta'dib: *Jurnal Pendidikan Islam*, 9(1), 51–62.

Gall, M. D., Gall, J. P., & Borg, W. R. (2003). *Educational Research: An Introduction* (7th ed.). Boston: Allyn & Bacon.

Halim, A., Fitria, Y., & Rahmadani, A. (2023). Pengaruh penggunaan e-book terhadap hasil belajar dan minat baca siswa di era digital. *Jurnal Inovasi Pendidikan Sains*, 11(1), 45–53.

Harfian, L. P. (2015). *Pengembangan Bahan Ajar Berbasis Kontekstual pada Materi Ekosistem untuk Siswa SMP*. Tesis tidak diterbitkan. Universitas Negeri Yogyakarta.

Heinich, R., Molenda, M., Russell, J. D., & Smaldino, S. E. (2022). *Instructional media and technologies for learning* (10th ed.). New York: Pearson Education.

Hodges, C., Moore, S., Lockee, B., Trust, T., & Bond, A. (2020). The difference between emergency remote teaching and online learning. *Educause Review*. https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning

Huang, R. H., Spector, J. M., & Yang, J. (2020). *Digital learning: Enabling technologies, pedagogies and competencies for future education*. UNESCO and Springer.

Hwang, G. J., Chiu, L. Y., & Chen, C. H. (2020). A Contextual Game-Based Learning Approach to Improving Students' Inquiry-Based Learning Performance in Social Studies Courses. *Computers & Education*, 144, 1-14.

Kemendikbud. (2022). *Materi Pelajaran IPA SMP Kurikulum 2013 Revisi*. Jakarta: Kementerian Pendidikan dan Kebudayaan.

Lestari, S., & Hidayat, R. (2023). *Bahasa dalam pembelajaran: Prinsip dan penerapannya di sekolah dasar*. Jakarta: Literasi Nusantara.

Manurung, S. R., Siregar, L. Y., & Suryadarma, I. G. P. (2020). Argument-Driven Inquiry (ADI) Learning Model: A Systematic Literature Review. *Journal of Physics: Conference Series*, 1521(4), 1-8.

Mayer, R. E. (2021). *Multimedia learning* (3rd ed.). Cambridge: Cambridge University Press.

Mishra, P. (2020). Considering context in TPACK research: The missing third element. *Journal of Educational Computing Research*, 57(4), 1032–1053. https://doi.org/10.1177/0735633118798523

Mutia, R. (2015). Penerapan Model Pembelajaran Argument-Driven Inquiry untuk Meningkatkan Keterampilan Argumentasi Siswa pada Materi Ekosistem. *Jurnal Bioedukatika*, 3(2), 15-20.

Nizar, M., Sutrisno, H., & Wibowo, H. (2022). Pengembangan e-book interaktif untuk meningkatkan kemandirian belajar siswa di era digital. *Jurnal Teknologi Pendidikan*, 10(2), 115–124.

Norman, D. A. (2016). *The design of everyday things* (Revised and expanded ed.). MIT Press.

Prawiradilaga, W. (2020). *Desain sistem pembelajaran: Konsep, prinsip, dan aplikasi untuk membantu perancangan pembelajaran yang efektif*. Jakarta: Kencana.

Rahmiati, D., & Retnawati, H. (2023). Validitas isi dalam pengembangan perangkat pembelajaran berbasis kompetensi. *Jurnal Evaluasi Pendidikan*, 14(1), 45-56.

Riduwan. (2016). *Skala Pengukuran Variabel-variabel Penelitian*. Bandung: Alfabeta.

Ryan, M., & Ryan, M. (2015). A model for reflection in the pedagogic field of higher education. *Teaching in Higher Education*, 20(3), 1–13. https://doi.org/10.1080/13562517.2015.1005866

Saifuddin Azwar. (2015). *Penyusunan Skala Psikologi*. Yogyakarta: Pustaka Pelajar.

Sampson, V., Grooms, J., & Walker, J. P. (2010). Argument-Driven Inquiry as a Way to Help Students Learn How to Participate in Scientific Argumentation and Craft Written Arguments: An Exploratory Study. *Science Education*, 95(2), 217-257.

Schugar, H. R., Smith, C. A., & Schugar, J. T. (2013). Teaching with interactive picture e-books in grades K-6. *International Reading Association*, 66(8), 615– 624. https://doi.org/10.1002/TRTR.1168.

Sugihartono, R. (2022). *Psikologi pendidikan: Panduan praktis untuk guru dan pendidik*. Bandung: Remaja Rosdakarya.

Sugiyono. (2015). *Metode Penelitian Pendidikan: Pendekatan Kuantitatif, Kualitatif, dan R&D*. Bandung: Alfabeta.

Sungkono, A. (2021). *Strategi penyajian materi ajar yang efektif dan efisien*. Malang: Pustaka Cendekia.

Sweller, J., van Merriënboer, J. J. G., & Paas, F. (2019). Cognitive architecture and instructional design: 20 years later. *Educational Psychology Review*, 31(2), 261–292. https://doi.org/10.1007/s10648-019-09465-5

Thiagarajan, S., Semmel, D. S., & Semmel, M. I. (1974). *Instructional development for training teachers of exceptional children: A sourcebook*. Bloomington, IN: Indiana University.

Tuch, A. N., Roth, S. P., Hornbaek, K., Opwis, K., & Bargas-Avila, J. A. (2016). Is beautiful really usable? Toward understanding the relation between usability, aesthetics, and affect in HCI. *Computers in Human Behavior*, 28(5), 1596–1607. https://doi.org/10.1016/j.chb.2012.03.024

UNESCO. (2021). *Education for Sustainable Development: A Roadmap*. Paris: UNESCO Publishing.

Vassiliou, M., & Rowley, J. (2008). Progressing the Definition of "E-Book". *Library Hi Tech*, 26(3), 355-368.

Walker, J. P., & Sampson, V. (2013). Learning to Argue and Arguing to Learn: Argument-Driven Inquiry as a Way to Help Undergraduate Chemistry Students Learn How to Construct Arguments and Engage in Argumentation During a Laboratory Course. *Journal of Research in Science Teaching*, 50(5), 561-596.

Wedyawati, N. dan Lisa, Y. (2019). *Pembelajaran IPA Di Sekolah Dasar*. Yogyakarta: Deepublish.