

## Development of an E-Book Based on Local Wisdom of Fish Ponds in Gresik to Train Scientific Reasoning Skills

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### ABSTRACT

**Objective:** Scientific reasoning is one of the most essential skills in learning biology and can be trained by integrating local wisdom. The lack of learning media that facilitates student learning causes low students' scientific reasoning skills. The development of learning media that integrates local wisdom is needed to train students' scientific reasoning. **Method:** The e-Book development procedure uses the ASSURE model which consists of six stages namely (1) analyze learner characteristics, (2) state objectives, (3) select, modify or design media, (4) utilize media, (5) requires learner responses, dan (6) evaluate. Data collection was collected by validation, observation, tests, and student response questionnaires. The One-Group Pretest-Posttest Design was implemented at Muhammadiyah 10 High School Surabaya for the 2022/2023 school year. **Results:** The results showed that (1) the developed e-book was valid with an average validity value of 93%, (2) learning implementation was 92.5% at the first meeting, and 81% at the second meeting with the high category, (3) student learning outcomes in the scientific reasoning indicator increased to 88% in probabilistic reasoning, 82% in theoretical reasoning, 80% in correlation reasoning and 79% in proportional reasoning, as well as the n-Gain calculation results which with high criteria and (4) positive student responses to the use of e-books. So that the developed e-book is feasible to use in terms of local wisdom potential, e-book validity, practicality, and e-book effectiveness. **Novelty:** The development of an e-book on ecosystem material with the integration of local wisdom from fish ponds to train scientific reasoning skills has never been done before.

## INTRODUCTION

Scientific reasoning is the most important skill in learning science, including biology (Luo et al., 2020; Wu et al., 2016). Science learning requires reasoning, problem solving and decision making critically and creatively (Yanto et al., 2019). Based on the output, scientific reasoning can be identified as student arguments (Fischer et al., 2014) which are reinforced by the results of analysis and evaluation in the form of data and facts (Mayer et al., 2014; Bao et al., 2009). The scientific reasoning process involves a structure in argumentation to claim data, link relationships, and collect supporting data (Khan & Rana, 2021) especially on anomalous data (Meister & Upmeier, 2021). The quality of students' arguments is closely related to the reasoning process (Ding, 2018). So scientific reasoning can be assumed to be a process of reconstructing reasoning and argumentation to determine the characteristics of arguments (Vaesen & Houkes, 2021). Students with scientific reasoning skills can solve various systematic problems to reach valid conclusions (Zlatkin et al., 2020). However, students' scientific reasoning abilities in Indonesia are currently still low (Yediarani et al., 2019).

The use of information technology in education can facilitate the student learning process by adding simulations and providing attractiveness in learning materials so as to increase student enthusiasm for learning (Chang & Yu, 2018). Supported by the fact that students in this era are accustomed to accessing the internet through gadgets to obtain new information and knowledge (Amin, 2016). This underlies the use of technology as a learning medium because it can continue to develop (Astuti et al., 2019), one of which is by using e-Books. Currently, the habits of technology-savvy readers have shifted to using e-books (Hu, 2016). Interesting features provided by e-Books such as hyperlinks, audio-visual, flip animation, search features (Askar, 2014) and easy access (Tosun, 2014) make the use of printed books less attractive (Susantini et al., 2021).

Technology that continues to develop not only has a positive impact, but also has a negative impact. Positive impacts because ICT can provide new, broader knowledge information (Susantini et al., 2021). Fajarini and Handayani (2020) reports that one of the negative impacts of modern technological developments is the fading of local wisdom. In fact, local wisdom can be used to help students understand biology concepts (Dewi et al., 2017). This is a potential to integrate local wisdom values in learning through media in the form of e-books. One example of local wisdom that can be integrated into an e-book is fish ponds.

ICT-based learning media integrated with local wisdom to train scientific reasoning is not the first time this has been done. Kundariati & Rohman (2020) have developed an encyclopedia based on local potential to train scientific reasoning that is effective for use. Apart from that, Putri et al. (2021) have developed an atlas to train scientific reasoning, which shows an increase in scientific reasoning skills in students. This research chose e-books because they can improve students' understanding compared to printed books (Tsai, 2018). In addition, the use of e-books is based on students' habits, who are accustomed to quickly searching for content (Lin et al., 2015). The novelty of this research is the integration of local wisdom from fish ponds in Gresik into an e-book to practice scientific reasoning.

The local wisdom of fish ponds in the Cerme District area, Gresik Regency, East Java is the abundance of tamarind trees (*Tamarindus indica*) around the ponds. This is because the local people believe that by sticking a branch from the tamarind tree on the edge of the pond they can overcome the *Chaetomorpha* sp. which affects fish growth. However, the public does not know the scientific reasons for this phenomenon. So that a scientific study is needed to explain it. This is in accordance with the "kurikulum merdeka" on ecosystem material with phase E biology learning outcomes, namely "Students have the ability to create solutions to problems based on local, national, or global issues related to understanding the diversity of living things and their roles, viruses and their roles, biological technological innovation, components of an ecosystem, interactions between components, and environmental changes" (Kemdikbud). Through the integration of this local wisdom in the e-Book, students' scientific reasoning skills will be trained to be able to provide scientific reasons related to this phenomenon. So, e-books based on the local wisdom of fish ponds in Gresik can help students practice their scientific reasoning skills.

## RESEARCH METHOD

### *Research Design*

The type of research used in this research is research and development. This study aims to develop an e-book based on local wisdom which was developed based on the ASSURE model. The reason for using the ASSURE model is because the ASSURE model is designed to develop media and technology to increase learning effectiveness (Russell, 2014). The ASSURE model consists of six stages namely analyze learner characteristics, state objectives, select, modify or design media, utilize media, requires learner respons, dan evaluate.

### **Research Place**

This research was conducted at the Faculty of Mathematics and Natural Sciences, Surabaya State University and Senior High School of Muhammadiyah 10 Surabaya in the 2022/2023 school year with a total of 35 high school students of X MIPA 2. The research design used is the One-Group Pretest-Posttest Design.

### **Instruments and Procedures**

Data collection was carried out by validation, observation, tests, and student response questionnaires. Validation is collected by using a validation sheet to determine the validity of the e-book being developed. Observations were made during the learning process using observation sheets to determine the practicality of the e-book being developed. The essay test is in the form of reasoning questions with four indicators of scientific reasoning according to Bao et al. (2018), namely Proportional reasoning, correlation reasoning, Probabilistic reasoning, and theoretical reasoning. Student response questionnaire after using the e-book is used to measure the effectiveness of the e-book being developed.

### **Data Analysis**

The e-book validity analysis technique is carried out using a validation sheet. Validity assessment using a four-point Likert scale.

**Table 1.** Four Point Likert Scale Table, Arikunto (2014)

Scale (%)	Category
1	Less
2	Fairly Good
3	Good
4	Very Good

The results of the validity assessment are then calculated on average using the formula:

$$Mean (M) = \frac{\sum \text{scores obtained from all validators}}{\sum \text{Max score}}$$

The average results that have been obtained are then converted into percentages using the formula:

$$Validity (\%) = \frac{M}{\text{Max Scale}} \times 100\%$$

The results of the validity percentage obtained are then interpreted based on the Swanson quartile criteria as follows:

**Table 2.** Table of Score Interpretation Criteria based on Swanson Quartiles (2014)

Score (%)	Category
M% < 25%	Very Low Validity
25% < M% < 50%	Low Validity
50% < M% < 75%	Fairly Validity
M% > 75%	Valid

Based on this table, the e-book is declared valid if it gets an average percentage score (M)% > 75%.

Furthermore, a reliability test was carried out to determine the reliability of the developed e-book. The reliability test in this study used the Percentage Agreement (PA) or the Borich formula with the elaboration of the formula as follows (Retnawati, 2016):

$$PA = \left(1 - \frac{A-B}{A+B}\right) \times 100\%$$

Information:

A = The frequency of the observed behavior aspect by the observer and gives a high frequency

B = The frequency of the observed behavior aspect by the observer and gives a low frequency

The instrument is said to be reliable if the value of the Percentage Agreement (PA) ≥ 0.75.

Practicality analysis was carried out by observing the implementation of learning activities using an e-book based on local wisdom in the Gresik fish pond area to train students' scientific reasoning. Assessment of the observation sheet implementation of learning using a 4-point Likert scale (table 1). Observational questionnaire data were analyzed using the formula:

$$Score(\%) = \frac{\sum \text{the total score obtained}}{\sum \text{max score}} \times 100\%$$

The percentage results are then interpreted using the following criteria:

**Table 3.** Table of Score Interpretation Criteria based on Swanson Quartiles (2014)

Score (%)	Category
M% < 25%	Very Low
25% < M% < 50%	Low
50% < M% < 75%	Fair
M% > 75%	High

Based on this table, the e-book is declared practical if the implementation of the learning process gets a score percentage of > 50% or at least at a moderate level. Analysis of the effectiveness of e-books based on local wisdom in the Gresik fish pond area to train students' scientific reasoning was analyzed using learning outcomes data and student response questionnaire data. Learning outcome data were analyzed using N-Gain. Gain is the comparison between the average final grade score (posttest) and the average grade score at the end of learning (Hake, 1999). Students' pretest and posttest scores were analyzed using the N-Gain equation:

$$N - Gain = \frac{Posttest\ Score - Pretest\ Score}{Maximum\ Score - Pretest\ Score}$$

The results of the n-gain calculation are then interpreted into the following criteria:

**Table 4.** N-Gain Score Change Criteria (Hake, 1999)

Score	Category
> 0,70	High
0,30 - 0,70	Fair
< 0,30	Low

The criteria for scientific reasoning ability are determined using the standard deviation using the formula (Sudjono, 2017)

$$SD = \frac{1}{N} \sqrt{(N)(\sum f x^2) - (\sum f x)^2}$$

Information:

SD = Standard Deviation

$\sum f x^2$  = The sum of the multiplication results between x<sup>2</sup> and frequency

$\sum f x$  = The sum of the multiplication results between x and frequency

N = Number of frequencies/individuals

**Table 5.** Interpretation of Scientific Reasoning Ability Scores

Score	Category
$x \geq (M + 1\ SD)$	High
$(M - 1\ SD) < x < (M + 1\ SD)$	Fair
$x \leq (M - 1\ SD)$	Low

Information:

x = Student scores

M = Means

SD = Standard Deficiency

The mean is determined based on the following formula:

$$M = \frac{\sum f x}{N}$$

Information:

Mx = Average score sought

$\sum f x$  = The number of multiplication results between x from each interval with f

N = Number of Observers

Student questionnaire sheets regarding e-books based on local wisdom in the Gresik fish pond area to train students' scientific reasoning were analyzed based on the number of scores given by students. The score is then percentage by the formula:

$$\text{Index formula (\%)} = \frac{\sum Skor \times 100\%}{Y}$$

Information:

$\sum \text{score}$  :  $\sum T \times P_n$

Y : The highest score x  $\sum$  panelists

T : Total number of respondents who voted

P<sub>n</sub> : Choice of score numbers

The results of the percentage of student response questionnaires obtained are interpreted based on the following criteria:

**Table 6.** Interpretation Criteria Score based on Arikunto (2014)

Score (%)	Category
<40	Very Low
40-55	Low
56-65	Fair
66-79	High
80-100	Very Low

## RESULTS AND DISCUSSION

### Results

#### Analysis Stage

The collected student analysis includes general characteristics based on specific competencies and learning styles. This analysis was obtained through teacher interviews. General characteristics of students include age, which shows that students are in the age range of 16–17 years who are already in concrete and formal thinking so that they can be trained in scientific reasoning skills (Karplus, 2977). Students also have gadgets that are used in the learning process because Senior High School of Muhammadiyah 10 Surabaya does not use books in the learning process. However, these facilities are still not optimal because, based on the results of interviews with biology teachers, students still have difficulty knowing the benefits of learning material in biology subjects.

#### Stage State Objective

The local wisdom of Gresik fish ponds is integrated into biology learning in phase E of class X Senior High School of with Learning Outcomes "Students have the ability to create solutions to problems based on local, national or global issues related to understanding the diversity of living things and their roles, viruses and their roles, innovation biological technology, ecosystem components and interactions between components and environmental change." Creating a solution, namely by scientifically proving people's beliefs about *Tamarindus indica* branches, to overcome *Chaetomorpha* sp. blooms This evidence can be used as a solution to the *Chaetomorpha* sp. blooming problem, which can make it easier for farmers to cultivate. Apart from that, ecosystem components and interactions between components can be studied, one of which is the phenomenon of old water, namely the relationship between water pH (the abiotic component) and the condition of fish (the biotic component), which influence each other.

#### Stage Select, Modify or Design Media

The selection of media in the form of e-books is based on the consideration that during the learning process students do not use books, but use gadgets. The e-book is compiled by analyzing the content to be integrated with the local wisdom of fish ponds as the main subject based on the curriculum. The e-book consists of initial and final cover sheets, e-book features, a table of contents, concept maps, scientific reasoning and cognitive indicators, an introduction, and four sub-chapters, namely: (1) ecosystem components; (2) patterns of interaction in ecosystems; (3) energy flow; and (4) biogeochemical cycles. Each sub-chapter is equipped with exercise questions to practice scientific reasoning







skills and competency tests. The level of validity of the instrument must be high because the instrument is a measuring tool (Sürücü & Maslakçi, 2020). The following are validation results, according to experts:


**Table 7.** Validation Result Value

No.	Aspect	Value			Mean	V (%)	Interpretation	R (%)	Interpretation
		V1	V2	V3					
1.	Presentation feasibility	3.93	3.63	3.66	3.67	94	Valid	91	Reliable
2.	Content feasibility	3.92	3.50	3.66	3.69	92	Valid	94	Reliable
3.	E-book systematics	3.79	3.63	3.78	3.73	93	Valid	94	Reliable
Total Average					3.72	93	Valid	93	Reliable

Local wisdom-based e-books for practicing scientific reasoning have features that support the presentation of material. The following is a description of the features contained in the e-book.

**Table 8.** Features in the E-Book Based on Local Wisdom in the Gresik Fish Pond Area to Practice Scientific Reasoning Skills

No.	Feature	Information
1.		Sci-Reasoning Tips Study tips to practice scientific reasoning skills (Proportional Reasoning, Probabilistic Reasoning, Theoretical Reasoning, dan Proportional Reasoning).
2.		V-Check! Videos about learning materials that can be played to support learning.
3.		Bio-Fact Contains biological facts in ecosystem material that students need to know. The Bio-Fact display is presented in a pop-up.
4.		KeKal (KEarifan loKAL) Scientific reasoning questions based on local wisdom. The KeKal view is presented in a pop-up.
5.		Review Summary of the material that has been studied.
6.		Game Time Material review using snakes and ladders game which is accessed online. Game Time display! presented in a pop-up.

No.	Feature	Information
7.	 <b>Umpan Pena</b>	Umpan Pena (Uji kemaMPuAN PENalaran ilmiAh) Competency test questions to measure students' scientific reasoning abilities.

### Utilize Media

The next stage is the trial of the E-book based on local wisdom in the Gresik fish pond area to train students' scientific reasoning skills because the e-book has been valid and reliable. The trial was carried out at Senior High School of Muhammadiyah 10 Surabaya in X MIPA. The e-books can be accessed via <https://ebookbiologi.com> with student's smartphones or laptops and assisted by the teacher who displays the e-books on a projector to facilitate coordination with students regarding the pages and interactive features provided.

During the learning process, observations were made to find out the practicality of the e-book in training scientific reasoning indicators. The following is data from observations of the activity of using e-books based on local wisdom, the results of the learning activities of 35 students at meetings I and II are as follows.

**Table 9.** Score of Observation Results of Meetings I and II

No.	Scientific Reasoning Indicator	Meeting I	Meeting II
1.	<i>Theoretical Reasoning</i>	96.3	80
2.	<i>Correlational Reasoning</i>	100	86
3.	<i>Proportional Reasoning</i>	87.5	70
4.	<i>Probabilistic Reasoning</i>	75	85
	Average	92.5	81

### Require Learner Responses

Student learning outcomes were analyzed using the N-Gain formula based on the results of the pretest and posttest that had been done. The following are the results of the pretest, practice questions and posttest of students' scientific reasoning skills to find out students' scientific reasoning skills.

**Table 10.** Scores of Student Scientific Reasoning Skills Test Results

Information	Score			N-Gain	Category
	<i>Pretest</i>	<i>Exercise</i>	<i>Posttest</i>		
Average	15.41	85.41	82.77	0.79	High
Standard Deviation	5.3504	5.1921	3.7036		

These results are then calculated based on each indicator of scientific reasoning. The following is students' average pretest and posttest scores based on scientific reasoning indicators.

**Table 11.** Scores of Student Pretest-Posttest Results Based on Student Scientific Reasoning Indicators

Indikator Scientific reasoning	Pre	Pre %	Post	Post %	N-Gain
Theoretical Reasoning	0.08	4	1.63	82	0.81



Proportional reasoning	0.21	10	1.59	79	0.77
Probabilistic reasoning	0.79	39	1.75	87	0.79
Correlation Reasoning	0.07	3	1.60	80	0.79

Student response data was obtained after the learning process using the e-book took place. The following is the score of the results of student responses after using the e-book

**Table 12.** Data Summary Analysis of Student Learning Outcomes

No.	Aspect	Score (%)
1.	Quality of Use	100
2.	E-book presentation	97
3.	Material Content	95

### Evaluate

The evaluation was carried out based on the results of the validator's assessment in the form of a revision of the e-book based on the validator's suggestions. The validator's suggestions include explaining the scientific reasoning indicators in full, adding information about the scientific reasoning indicators to each KeKal feature question, adding hyperlinks to article links for student reference, adding simple practicums, changing the design of the bio-fact feature, and replacing videos in English with videos in Indonesian.

### Discussion

Local wisdom-based e-books to train students' scientific reasoning skills based on validation results are valid with a validity percentage of 93% and reliable with a percentage of 93%. In the feasibility aspect, it gets a validity of 94% because the e-book being developed is made in full color, with pictures, and is designed with the selection of fonts and neat layout proportions. Supported by attractive features and ease of use e-books. This feature is made by utilizing the advantages of e-books, namely interactive features such as graphic content, audio-visual, video, hyperlinks to support online streaming and quizzes (Askar, 2014). Preparation of e-books that maximize interactive features because the use of learning media with interactive features can support students to focus more on ongoing learning (Ramdani & Wahab, 2021). Interactive e-books allow students to interact with media in the form of e-books so that learning will be more meaningful and make learning more effective (Sari et al., 2023; Huang et al., 2018). In the feasibility aspect, the content validity obtained was 92%. Preparation of e-books based on local wisdom can help students understand the material presented so that positive character and academic intelligence will grow significantly (Parwati et al., 2018). In the systematic aspect of the e-book, it gets a validity score of 93% in the valid category. This is because e-books are arranged sequentially so as to facilitate students in learning activities. This is because books are an important factor supporting achievement (Polikoff et al., 2020). Books are facilities that can provide equal learning opportunities in the learning process (Bellens et al., 2020). The use of e-books can facilitate students' habits in quickly searching for content on the internet (Lin et al., 2015). E-book also flexible because can be open by computer or smartphone (Tsai et al., 2018).

Based on table 9, the results of the practicality analysis of the e-book based on the scientific reasoning indicator show a value of 92% at the first meeting and 81% at the

second meeting. The first meeting students do practicum with the PBL learning model. The use of learning models that make students the center of learning can help students be more active because students learn with challenges and investigations independently (Fadlilah & Herlanti, 2023). The teacher's role in the learning process is as a facilitator who presents problems and guides investigations (Shofiyah et al., 2018). At the second meeting, the learning model used was cooperative. Students discuss to find solutions to the problems presented to practice their reasoning skills. The teacher acts as a facilitator who is also able to create a conducive learning atmosphere between teachers and students and between fellow students (Wulandari & Kunci, 2022). Discussion activities are carried out by exchanging opinions or exchanging arguments (Hasanah, 2020; Mufaikhah A, 2019) which is the output of scientific reasoning skills and can increase understanding of scientific processes (Nurmilawati et al., 2021).

Based on table 10, the pretest score of 35 students was 15.41 with a maximum score of 100. These results increased in the posttest by 85.41 with a maximum score of 100. The results of data analysis of student learning outcomes using N-Gain showed that the average N-Gain score of 35 students was 0.80. The lowest N-Gain value is 0.62 with medium criteria and the highest is 0.89 with criteria for changing the N-Gain score  $> 0.70$  gets high criteria. Preliminary data shows that the value of 35 students' scientific reasoning skills is still in the low category with a standard deviation of 4.3504 and has decreased to 3.7036 at the end of the lesson. The results of the analysis of scientific reasoning abilities based on scientific reasoning indicators show an increase in both theoretical reasoning, proportional reasoning, probabilistic reasoning and correlation reasoning. A high N-Gain value indicates that students are used to and able to solve problems related to local wisdom with their reasoning abilities. This is due to problems regarding local wisdom being able to improve problem solving abilities related to scientific reasoning skills (Nugraha et al., 2017).

Based on table 11, students' initial ability on each indicator of scientific reasoning is low. The low theoretical reasoning indicator is because students have not yet mastered how to connect an event with interconnected concepts (Firdausi et al., 2020). The proportional reasoning indicator is caused by students who still have not mastered the ability to determine variable comparisons and interpret relationships between variables (Nurdiani et al., 2019; Hadi et al., 2021). The probabilistic reasoning indicator is because students are still unable to interpret the data presented (Puspita Hadi et al., 2021). The correlation reasoning indicator is because students are still not able to correlate the variables contained in an event to produce a scientific explanation (Firdausi et al., 2020). Even though Piaget identified that students with middle school age were already at the stage of concrete and formal thinking which is part of reasoning (Karplus, 1977). The increase in student scores is related to the presentation of supporting material and information Putri et al., 2021). Material and information obtained by students can activate students' reasoning processes (Novia & Riandi, 2017). The process of scientific reasoning requires good cognitive activity so as to produce knowledge that is long term memory (Khoirina et al., 2018; Susantini et al., 2021).

Based on table 12, students respond positively to the e-book being developed in terms of supporting features, appearance and material content that integrates local wisdom. Student responses are important in developing e-books to determine student interest in e-books and with comments and suggestions from students, errors and deficiencies in the

e-book can be corrected (Kartini et al., 2020; Rusli & Antonius, 2019). So that e-book development can be carried out optimally because students as users also have a stake in the development process.

## CONCLUSION

**Fundamental Finding:** Based on the results of the analysis and discussion, the e-book based on the local wisdom of fish ponds in Gresik to train scientific reasoning skills is feasible in terms of validity in the valid category, practicality in the high category, and effectiveness based on the n-gain value category in the high category and students' positive responses to e-books. **Implication:** Research products can be used in class X biology subjects to practice scientific reasoning skills. The research results can also be used as a basis for developing local wisdom-based learning media by utilizing technology. **Limitation:** preparation of practice questions and evaluation based on indicators of scientific reasoning is limited by local wisdom so that the number of questions for each indicator is not the same. **Future Research:** The development of an e-book based on the local wisdom of fish ponds in Gresik to train scientific reasoning skills can be directed to research the effectiveness of learning models that can maximize the use of e-books.

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