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Development of Science E-books Based on Local Wisdom to Improve Digital Literacy and Students' Critical Thinking Skills as An Innovation to Improve Education Sustainable Developments Goals (ESDG)

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Abstract: This study aims to produce a science e-book based on local wisdom that is feasible, practical, and effective to improve students' digital literacy and critical thinking skills. This research method is a development research using the 4D model. The subjects of this study were grade VIII students at one of the Mataram City Public Junior High Schools consisting of 3 classes. Data collection techniques used questionnaires, observation sheets and test instruments developed according to critical thinking and digital literacy indicators. Data analysis techniques used Aikens'V for the feasibility test, practicality percentage test and normalized gain test to test the hypothesis. Based on the results of the study, it was found that the science e-book based on local wisdom that was developed was included in the category of feasible, practical and effective for use in science learning and could improve students' digital literacy and critical thinking skills. Science e-books based on local wisdom support students in the learning process by utilizing technology. The use of science e-books based on local wisdom makes it easier for students to learn and provides fun and up-to-date things. Learning using science e-books based on local wisdom encourages students to learn actively and creatively because it is accompanied by exploratory tasks.

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Introduction

The Ministry of Education and Culture (Kemendikbud) in collaboration with the Ministry of Communication and Informatics (Kemkominfo) is actively improving digital literacy in the community (Pratama, et al., 2019). This aims to enable the community to use the internet and electronic devices correctly and with dignity (Sugiarto, et al., 2023). One of the efforts of this digital literacy movement is to familiarize students in schools with the skills to carry out digital literacy activities. In addition, digital literacy skills in Indonesia are still low. This is referred to based on the results of the Program for International Student Assessment (PISA) in 2022, Indonesia's reading/literacy level was ranked 62 out of 70 countries with an average score of 397. The average reading/literacy score from 70 countries was 493. This means that the reading/literacy level in Indonesia is still low and below average (Nandiasoka Annisawati, P., & Ika Oktora., 2024).

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Digital literacy is one of the six basic literacies that are applied mainly in learning activities (Quaicoe & Pata, 2020). Digital literacy can be developed through electronic-based learning (e-learning) based on a learning management system (LMS) (Mahmudah, et al., 2023). One of the LMS is an electronic book. In addition to the problem of digital literacy, students in Indonesia are also faced with the problem of low critical thinking skills. The critical thinking skills of students in Indonesia are still low. Ramdani, et al (2021) revealed that students' critical thinking skills are still low as seen from the symptoms of problems that dominate the results of observations during the science learning process in class. The symptoms of the problems in question include: (1) difficulty in working on questions that measure high-level thinking skills (C4-C6); (2) many of them find it difficult to connect concepts and problems; (3) some of them have difficulty expressing their opinions during discussions. Critical thinking is a very essential skill for life and functions effectively in all aspects of life (Elder & Paul, 2020).

Various educational research results show that critical thinking can prepare students to think in various disciplines, and can be used to prepare students for their careers and real lives (Lamaro, et al., 2024). Furthermore, Lamaro et al (2024) stated that various educational research results show that critical thinking can prepare students to think in various disciplines, and can be used to prepare students for their careers and real lives. On the other hand, problems related to the development of critical thinking in learning often escape the attention of teachers. The development of critical thinking is only expected to appear as a side effect (Taimur & Sattar, 2020). The solution to this problem is to develop learning media that combines the use of each student's cellphone as the main access to use media to train students' digital literacy skills (Sulasmi, 2022).

E-books are learning media that are very suitable for learning media in today's modern era which contain materials, questions, and evaluations to achieve learning objectives electronically (Hadaya & Hanif, 2019). Integration of digital literacy indicators with electronic-based learning (e-books). Saripudin, et al (2022) expressed the opinion that this E-book can influence the younger generation, a generation that understands technology and thinks independently. Learning using science e-books integrated with local wisdom is expected to improve the quality of learning which is currently still low (ESDGs). This is in accordance with the opinion of Hwang and Ham (2021) who stated that several indicators include: students have difficulty asking questions and defining problems, actual problem literacy is still lacking, analytical and evaluative problem solving is still low, skills in identifying, analyzing, and evaluating selective arguments are still low. This study aims to produce a science e-book based on local wisdom that is feasible, practical, and effective to improve students' digital literacy and critical thinking skills.

E-books are learning media that are very suitable for use as learning media in the modern era today which contain materials, questions, and evaluations to achieve learning objectives electronically (Hadaya & Hanif, 2019). Integration of digital literacy indicators with electronic-based learning (e-books). Saripudin, et al. (2022) expressed the opinion that this E-book can influence the younger generation, a generation that understands technology and thinks independently. Learning using science e-books integrated with local wisdom is expected to improve the quality of learning which is currently still low (ESDGs). This is in accordance with the opinion of Hwang and Ham (2021) who stated that several indicators include: students have difficulty asking questions and defining problems, actual problem literacy is still lacking, analytical and evaluative problem solving is still low, skills in identifying, analyzing, and evaluating selective arguments are still low. The novelty of this study is an innovation in the development of science e-books based on local wisdom which is

designed to improve students' digital literacy and critical thinking skills in supporting the achievement of the Education Sustainable Development Goals (ESDGs). Previous research conducted by experts only developed e-books that focused more on improving understanding of science concepts without considering the relevance of local culture by integrating the ESDG concept. This research produces digital teaching materials that not only strengthen students' critical thinking skills and digital literacy, but also instill local wisdom values that are relevant to their lives. This research focuses on making science learning more contextual, meaningful, and in line with the needs of the 21st century and sustainable development goals in education. This research aims to produce a science e-book based on local wisdom that is feasible, practical, and effective in improving students' digital literacy and critical thinking skills.

Research Method

This study used a research and development method (R&D) with a 4D development model (define, design, develop, and disseminate) (Thiagarajan 1974). The first stage, Define, is carried out to identify needs and problems in learning through literature studies, interviews, and observations. This analysis aims to understand the characteristics of students, the suitability of the curriculum, and the needs in product development to be relevant to the learning context. In addition, learning task analysis is carried out to ensure that the product being developed is able to answer the challenges in improving the quality of education. After the needs are identified, the next stage is Design, where the initial product begins to be designed based on the results of the previous analysis. At this stage, the developer prepares a conceptual framework, determines the content of the material, prepares a storyboard, and selects media and formats that are appropriate to learning needs. The initial prototype of the product is developed by paying attention to pedagogical aspects, readability, and integration with the right learning approach so that it can be applied effectively in the learning process. Furthermore, the Develop stage is carried out by involving expert validation, limited trials, and revisions based on the feedback obtained. Validation is carried out by experts in the fields of education, materials, and learning technology to ensure that the product being developed has good quality in terms of content, design, and usability in the learning process. After going through the validation stage, the product is tested on a small scale by involving groups of students and educators to assess its effectiveness and practicality in real learning situations. The results of this trial become the basis for making improvements and refinements before the product is implemented more widely. The last stage is Disseminate, where the product that has gone through the development stage is disseminated to wider users, such as teachers and students in various educational institutions. Product implementation is carried out by involving more students to test its effectiveness in real learning. The subjects of this study were grade VIII students at one of the State Junior High Schools in Mataram City consisting of 3 classes.

Data collection techniques using questionnaires, observation sheets and test instruments. Data analysis techniques using Aiken's V which was assessed for its feasibility by expert lecturers and media experts filling out validation forms to validate learning devices. This is in accordance with the opinion of Himawan, et al. (2024) who stated that to measure the validity of e-books using Aiken's V. The percentage of practicality is used to determine the practicality of science e-books based on local wisdom and the normalized gain test is used to determine the increase in digital literacy and critical thinking skills of students. This is in line with the data analysis technique carried out by Ramdani, et al. (2024) to measure practical media using the percentage of practicality.

Results and Discussion

Definition Results

Definition is done by collecting information by conducting literature studies and interviews with educators and students. Interviews with educators are related to planning, implementation, and evaluation of learning. The results of the interviews show that the independent curriculum learning. The implementation of learning is still dominated by educators (teacher center). The methods used vary depending on the learning material. Such as lectures, discussions, and presentations, and group work,

Based on the results of field studies at schools At this stage, researchers conducted activities in the form of problem analysis, curriculum analysis, and task analysis. The problem analysis carried out showed that the learning process in the classroom showed that students only obtained information from educators without processing the information further and did not relate the material to everyday life, and educators rarely used media as a learning resource. Meanwhile, the school has adequate facilities and infrastructure for learning, including computer laboratories and LCDs, but their use has not been maximized so that students are less active and less interested in learning

Based on the preliminary study that has been carried out, it is known that science learning is considered a difficult lesson because of the abstract, microscopic and symbolic concepts that are difficult to explain by student handbooks. This causes students to feel bored and less interested in chemistry lessons, which has an impact on the passive classroom atmosphere. Meanwhile, the school has adequate facilities and infrastructure for learning, including computer laboratories and LCDs, but their use has not been maximized so that students are less active and less interested in learning. Students need learning innovation through the development of PBL-based science e-modules, where abstract, microscopic science materials can be explained through problem-based chemistry learning website media that are developed.

The results of other studies conducted by Arywiantari et al. (2015) at SMPN 3 Singaraja also showed that student learning outcomes were relatively low in science subjects. This is because science learning is still done by memorizing so that students tend to feel bored and tired of learning. In addition, teachers have not been able to develop effective learning media. So it is necessary to develop learning multimedia in science subjects that will create interactive, inspiring, fun, challenging and motivating learning. Learning facilities at the school are very adequate, seen from the classrooms that already have LCDs, and multimedia laboratory rooms that greatly support the development of learning multimedia.

Design Results

The researcher compiled a science e-book product based on local wisdom by creating a flowchart and storyboard. Then collect supporting materials such as photos, videos, animations, and images. All collected materials are then entered into the professional flipped pdf computer program application by referring to the flowchart and storyboard. The science e-book based on local wisdom uses the Problem Based Learning (PBL) learning model. The creation of flowcharts and storyboards aims to provide an overview of the form and content of the display on multimedia. Flowcharts and storyboards are the first references for researchers to develop science e-book media based on local wisdom into a complete product.

The results of another study conducted by Handayani, et al (2023) at the design stage, the purpose of this stage is to design an initial draft of the PBL-based science e-module to be developed. The design stage can be broadly described as follows: (1) Formulating the concept of the material, where the concept of this material is in the form of a concept map (Pre-Production); (2) Compiling an interactive website learning media (Production); (3) Complete

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the design of this interactive website learning media and publish it via the internet (Finishing).

The creation of flowcharts and storyboards aims to provide an overview of the form and content of the display on multimedia. Flowcharts and storyboards are the first references for researchers to develop science e-books based on local wisdom. The results of the science e-module products that are created are then packaged in a learning link as a product design. Link for the science e-book based on local wisdom: https://heyzine.com/flip-book/895c1a4750.html. The appearance of the science e-book based on local wisdom is as shown in Figure 1.

Figure 1. Display of Local Wisdom-Based Science E-Module

Development Results

The development stage includes activities to develop the required devices. The learning devices required are ATP, Teaching Modules, Science E-books, digital literacy instruments and Critical Thinking instruments for students. The results of product development are listed in Table 1.

Table 1. Product Development Results

No	Product	Characteristics of Developed Products
1	ATP	Vibration and wave material
2	Teaching Module	Learning model: problem-based learning (PBL).
3	Science E-Book	Science e-module that has characteristics in the form of text, graphics, images, photos, videos, digital literacy indicators and critical thinking. Integration of indicators of both variables to train these variables.
4	Digital Literacy Instrument	Digital literacy instruments are developed based on students' digital literacy
5	Critical Thinking Instrument	Critical thinking instruments are developed based on students' critical thinking indicators

The problem-based PBL-based science e-module presents learning materials with a more attractive and informative appearance. This aims to facilitate and increase students' interest in learning. Website media can explain parts of abstract and microscopic concepts that cannot be explained in more detail by other learning resources.

The results of another study conducted by Sianturi, et al (2021) at the development stage aimed to produce a feasible interactive e-Book learning resource after being validated

and revised based on input from experts. This stage includes media reviews by media experts and chemistry teachers. The media review that has been designed is carried out by two media experts and 1 teacher. The reviewers were asked to provide input and suggestions for the interactive e-Book that was developed based on the suitability between the initial concept of developing the interactive e-Book and the systematics of the interactive e-Book produced. The PBL-based science e-module is a very important component in helping the learning process, as an effort to reduce the role of educators in learning, so that it can optimize the level of students' understanding of the material being taught.

Validation Phase Results

Validation was conducted by three experts who are competent in their fields. The learning products assessed were ATP, teaching modules, e-modules, digital literacy tests and critical thinking tests. The results obtained based on the expert validation results are listed in Table 2.

Table 2. Expert Validation Test Results

Validator	ATP (%)	Teaching Module (%)	E-Module (%)	Digital Literacy Instrument (%)	Critical Thinking Instrument (%)
I	90,00	82,50	88,00	87,50	84,00
II	82,50	75,00	80,00	77,50	76,00
III	80,00	70,00	78,00	77,50	72,00
Average	84,10	75,80	82,00	80,80	77,30

Table 2 shows that the average percentage of ATP eligibility is 84.1% with very high validity criteria, the average percentage of Teaching Module eligibility is 75.8% with high validity criteria, the average percentage of Science e-module eligibility is 82.0% with very high validity criteria, the average percentage of Digital Literacy Instrument eligibility is 80.8% with high validity criteria, the average percentage of critical thinking instrument eligibility is 77.30% with high validity criteria. Based on the average percentage of 75-85 with valid criteria. The results of another study conducted by Samudra and Yulkifli (2021) at the validation stage of interactive inquiry-based learning media used four validators, namely one media expert validator, two material expert validators, and one language expert validator.

The validation results from the four validators on the media, material, and language aspects each gave a good score so that good/feasible criteria were obtained. The resulting product development is inquiry-based. Discovering concepts through self-discovery or inquiry will make students more meaningful. This is in accordance with the results of media development from Yustiqvar, et al (2019) who obtained the results of the validation of the development of learning media with a valid category or having a good level of validity. In addition, the results obtained by Ramdani, et al (2020) were also no different, they obtained valid learning multimedia validation results. Iskandar et al. (2023) also obtained valid interactive learning multimedia results because all validity criteria had been met.

Questionnaire data of educators' and students' responses to the use of local wisdom-based science e-books.

Data analysis of responses to products developed by researchers to obtain data on the level of practicality of the learning process, researchers gave questionnaires to teachers and students to fill out. This shows the response of model teachers and students to the local wisdom-based science e-books that have been implemented. The results obtained based on teacher and student responses are listed in Tables 3 and 4.

Table 3. Percentage of student response results

Respondents	Interest in Science E-books	Ease of Use	The Role of Science E-books in the Learning Process	Average
Students	82,33 %	77,71 %	78,90 %	79,64 %
Criteria	Very practical	Practical	Practical	Practical

Table 4. Percentage of teacher response results

Respondents	Content Quality and Objectives	Learning and Instructional Quality	Average
Teachers	86,10 %	82,5 %	84,3 %
Criteria	Very practical	Very practical	Very practical

Based on Tables 3 and 4, it can be seen that the average percentage of teacher and student responses to all aspects of learning have very practical criteria, so it can be concluded that local wisdom-based science e-books are practical to use in learning.

The results obtained are in line with the results obtained by the research of Aulia et al. (2024) which stated that the interactive multimedia developed has met the criteria of practicality with 80% of respondents stating that interactive multimedia is interesting and fun so that it is suitable for use in classroom learning. Other researchers also stated that students gave a positive response to the learning activities developed (Gunawan, et al., 2020), the responses of teachers and students to the products applied were in the category of very feasible and practical to be applied to science learning (Isatunada & Haryani, 2021), learning becomes more practical if using media as a learning aid (Gillett-Swan, 2017). The results of a wider field test have been conducted to determine the effectiveness of the local wisdom-based science e-book. The trial was conducted in one school, namely SMPN Kota Mataram in 3 classes VII.

Digital Literacy

Data from the N-gain digital literacy test results were collected using a questionnaire sheet. Based on the results of the analysis that has been carried out, the overall digital literacy scores of students are listed in Table 5.

Table 5. Results of the Digital Literacy N-Gain Test

Class	Average		Average N-Gain (%)	Criteria N-Gain
	Pre-Test	*Post-test*		
VIII/a	34,91	86,98	84	Tall
VIII/b	35,37	83,73	82	Tall
VIII/c	29,64	80,90	76	Tall

Based on Table 5, it shows that the three classes VIIIa-VIIIc obtained an average improvement score with high criteria. These results indicate that there was an increase in students' digital literacy after learning using science e-books based on local wisdom.

Critical Thinking Data

Data from the n-gain critical thinking test results were collected using a description test instrument. Based on the results of the analysis that has been carried out, the overall critical thinking scores of students are listed in Table 6.

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Table 6. Critical Thinking N-Gain Test Results.

Class	Average		Average N-Gain (%)	Effectiveness Criteria
	Pre-Test	*Post-test*		
VIII/a	32.37	79.59	71	Tall
VIII/b	38.93	85.37	75	Tall
VIII/c	36.21	84.28	73	Tall

Based on Table 6, it shows that all three classes VIIIa-VIIIc obtained high criteria improvement scores. These results indicate that the increase in the average value of students' critical thinking improvement after learning using PBL-based science e-books.

There are several theoretical reasons that can be used as a basis for justifying the acquisition of digital literacy and critical thinking improvements with high criteria. This is related to learning using the local wisdom-based science e-book media model as an additional learning resource. Local wisdom-based science e-books are a very important component in helping the learning process, as an effort to reduce the role of teachers in learning, so that it can optimize the level of student understanding of the material being taught. Learning emphasizes student learning motivation by using local wisdom-based science e-books and is adjusted to the PBL model.

According to Hadi et al (2022) stated that interactive multimedia is more effective in improving learning achievement than printed media. Its use has also been proven to improve critical thinking skills in science learning (Fitriani, et al., 2020). In addition to science e-books based on local wisdom, the PBL learning model also plays an important role in learning because PBL learning is related to real life and the material taught is always associated with everyday life (Hsbollah & Hassan, 2022). The use of contextual learning on the material presented by educators will be more meaningful. The use of contextual learning will create a more active learning process, students are not just passive observers and are responsible for their learning (Nelson & Crow, 2014), so that with the mastery of concepts on learning materials which are continued with scientific literacy skills in students will make students' cognitive learning outcomes more optimal (Widiana, et al., 2015).

This is proven by the high enthusiasm of students in the experimental class in implementing learning. After the educator presents a statement in the form of a problem that stimulates students' curiosity according to their understanding. When the educator asks the reasons for their opinions, students try repeatedly to try to convey their reasons with a series of sentences that are continuously improved until they reach a point where students are unable to refute what the student said. This is what ultimately makes students doubt the truth of the concept conveyed by the educator, but have not been able to provide the right arguments because the characteristics of the material are abstract and symbolic which are difficult to explain in more detail by the student's handbook. Departing from this, the teacher facilitates students' learning by using a science e-book based on local wisdom. In this session, student enthusiasm was very high because educators believed that learning with science e-books based on local wisdom could provide new learning experiences for students. Students become more active in following the learning process carried out with the developed devices.

The developed local wisdom-based science e-book contains a series of activities that can stimulate students to solve problems presented in various ways and strategies so that they can bring out students' ability to explain phenomena scientifically from the students themselves. Based on the local wisdom-based science e-book that has been worked on by each group, a score is then given to measure students' understanding of the material that has been taught. Success during this learning process has an impact on students' digital literacy

skills. Students' critical thinking skills can be seen from the results obtained by students after working on the posttest questions. These questions emphasize students' experiences learning using local wisdom-based science e-books. So for students who are focused and serious during the learning process, they do not have much difficulty in working on the descriptive questions given.

The conceptual implications of this study are also closely related to the Education Sustainable Development Goals (ESDG), especially in supporting the achievement of SDG 4 (Quality Education) which emphasizes quality, inclusive, and equitable education. Through the development of digital-based e-books, this study contributes to preparing students to face the digital era by improving their digital literacy. Students' ability to access, evaluate, and use information effectively is an important part of the 21st century technology-based education system. In addition, the improvement of critical thinking skills obtained through this e-book is in line with the goals of sustainable education which emphasize problem-solving-based learning and responsible decision-making. By implementing an approach that emphasizes reflective and analytical thinking, students are encouraged to understand science concepts not only theoretically, but also in real contexts that are relevant to their lives.

Furthermore, this study also supports SDG 11 (Sustainable Cities and Communities) by incorporating elements of local wisdom into the learning process. The integration of local cultural and environmental values in teaching materials can foster students' awareness of the importance of maintaining the sustainability of their communities. By understanding how science can be applied in everyday life through a local perspective, students are expected to develop an attitude of caring for the environment, utilizing resources wisely, and contributing to sustainable development in their communities. In addition, the use of e-books as a digital learning medium also supports SDG 12 (Responsible Consumption and Production) by reducing dependence on printed teaching materials that have an impact on the exploitation of natural resources.

Conclusion

Based on the research results, the science e-book based on local wisdom produced is considered feasible, practical and effective to be applied in learning and improve digital literacy and students' critical thinking skills. Science e-books based on local wisdom support students in the learning process by utilizing technology. The use of science e-books based on local wisdom makes it easier for students to learn and provides fun and up-to-date things. Learning using science e-books based on local wisdom encourages students to learn actively and creatively because it is accompanied by exploratory tasks.

Recommendation

Recommendations for schools to use local wisdom-based science e-books as innovative learning resources in learning. Recommendations for further research to use local wisdom-based science e-books integrated with STEAM and SDGs to improve the quality of learning. Teachers need to integrate e-books into active learning by utilizing available digital features, such as interactive images, videos, and simulations. With this approach, students not only read the material but also engage in deeper exploration of concepts, thereby increasing their understanding and analytical power of scientific phenomena.

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