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DEVELOPMENT OF AN INTERACTIVE E-COMIC BASED ON LOCAL WISDOM FROM BLITAR, FEATURING PLANTS AS A SOURCE OF ENERGY, TO SUPPORT DIGITAL LITERACY AMONG FOURTH-GRADE STUDENTS AT UPT SDN MINGGIRSARI

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Persoalan yang kerap muncul dalam pembelajaran IPAS di tingkat sekolah dasar yaitu kurangnya daya tarik media pembelajaran, sehingga peserta didik mengalami kendala dalam menangkap isi materi serta kecakapan literasi digital mereka belum berkembang optimal. Menanggapi hal tersebut, dikembangkan sebuah media berupa *e-comic* interaktif yang mengusung kearifan lokal Blitar pada topik Tumbuhan sebagai Sumber Energi. Riset ini ditujukan untuk menghasilkan media yang teruji valid sekaligus efektif dalam mendongkrak hasil belajar dan literasi digital peserta didik. Metode yang dipakai berlandaskan *Research and Development* (R&D) dengan model ADDIE, terbagi atas lima tahapan yakni analisis, perancangan, pengembangan, implementasi, dan evaluasi. Penelitian ini melibatkan 15 peserta didik kelas IV UPT SD Negeri Minggirsari sebagai subjek. Data dihimpun melalui observasi, wawancara, angket validasi, serta pelaksanaan *pre-test* dan *post-test*. Hasil riset memperlihatkan bahwa media yang dihasilkan telah memenuhi kriteria valid berdasarkan penilaian para pakar. Di samping itu, instrumen yang dipakai juga terbukti valid dan andal, ditunjukkan dengan perolehan nilai *Cronbach's Alpha* sebesar 0,911. Rata-rata skor siswa melonjak dari 49,33 menjadi 91,93, sedangkan uji *paired sample t-test* menghasilkan nilai signifikansi 0,000.

Kata Kunci: *E-Comic Interaktif; Kearifan Lokal Blitar; Literasi Digital; Model ADDIE; Pembelajaran IPAS.*

Abstract

A recurring difficulty in primary-level Science and Social Studies (IPAS) teaching is that the media commonly relied upon lacks appeal, leaving learners struggling to absorb the content and hindering steady progress in their digital literacy. In response, an interactive e-comic medium rooted in Blitar's local wisdom was built around the topic of Plants as an Energy Source. This research set out to deliver a medium proven

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valid and effective at lifting learning outcomes and digital literacy among students. The study followed a Research and Development (R&D) design, anchored in the ADDIE approach spanning five sequential phases, namely analysis, design, development, implementation, and evaluation. Participants consisted of fifteen fourth-graders enrolled at UPT SD Negeri Minggirsari. Data were gathered through observation, interviews, validation questionnaires, plus pre-test and post-test scores. The outcomes confirmed that the resulting medium satisfied the validity criteria established by expert reviewers. Reliability was likewise confirmed, reflected in a Cronbach's Alpha coefficient of 0.911. Average student scores climbed from 49.33 to 91.93, and the paired-sample t-test yielded a significance value of 0.000.

Keywords: *Interactive E-Comic; Blitar Local Wisdom; Digital Literacy; ADDIE Model; Integrated Science and Social Studies Learning*

I. Introduction

The rapid development of digital technology requires the learning process in elementary schools to focus not only on delivering content but also on developing students' digital literacy skills. In the Merdeka Curriculum, the IPAS subject is designed to enable students to interpret various natural and social phenomena contextually through meaningful learning experiences. The "Plants as a Source of Energy" unit in fourth grade is an important topic because it relates directly to students' lives, particularly regarding the role of plants in producing energy through photosynthesis and their benefits for humans, animals, and the environment. Therefore, IPAS instruction requires engaging, interactive media that is relevant to students' daily lives so that the concepts presented do not feel abstract.

A number of previous studies have shown that visual and digital learning media can improve the quality of learning for elementary school students. Sugiantara (2021) developed an interactive e-comic on the topic of energy sources, and the results were deemed highly effective, as it received a 94% expert validation score and a 96% student response rate. These findings indicate that e-comics can guide students in grasping energy concepts through a combination of text, images, and engaging animations. In line with this, Ariyani's (2020) study further demonstrates that digital media in science education can sharpen students' critical thinking skills, creativity, and digital literacy. Furthermore, Wedayanti (2022) found that interactive digital comics based on the scientific approach are suitable and effective for deepening elementary school students' understanding of science concepts. In line with these findings, similar results were also supported by Niwangtika (2026), who developed an innovative educational game based on local wisdom to support science literacy and awareness of marine conservation among students in the coastal areas of Tulungagung. This research confirms that digital learning media incorporating local elements not only strengthen students' understanding of scientific concepts but also foster their concern for environmental sustainability, particularly marine ecosystems.

Other studies also confirm that learning media must not only be engaging but also incorporate contextual values and character development. Fatih (2021) developed the "Character Monopoly" game, which is based on simulation game mechanics, as an effort to develop the socio-emotional intelligence of elementary school students. The results of this study show that game-based media can be a powerful tool for fostering student engagement while developing their non-cognitive skills. Furthermore, Fatih (2024) created an augmented reality-based booklet using a PBL approach on the topic of ecosystem balance to boost fifth-grade students' science literacy. These findings confirm that the combination of digital technology, material visualization, and a contextual approach can support improvements in students' literacy in science and environmental studies.

Although the studies listed above have demonstrated the effectiveness of digital media, e-comics, educational games, and augmented reality in elementary school education, there are still gaps that have not been fully explored. Previous studies have tended to focus on the development of digital comics or digital media in general, but none have specifically designed interactive e-comics that integrate Blitar's local wisdom into the "Plants as a Source of Energy" curriculum to support the digital literacy of fourth-grade elementary school students. In fact, based on an interview with a fourth-grade teacher at UPT SDN Minggirsari on September 29, 2025, IPAS (Natural Sciences) instruction in the classroom is still dominated by lectures and simple discussions, while the use of visual and interactive media remains very limited. The learning resources used are still limited to worksheets and objects found around the classroom, so the delivery of material has not been optimal, and students are prone to getting bored quickly.

The innovative aspect of this study lies in the creation of an interactive e-comic based on the local wisdom of Blitar that highlights the potential and environment of the local area, such as Kidangan/Maliran, the Wlingi Tea Plantation, the Loji Area, as well as local crops like rice, sugarcane, cassava, and tea. These local elements are integrated into the storyline, illustrations, narration, navigation buttons, simple animations, and short quizzes, so that students do not merely read the material but also actively interact with the digital content. As a result, the developed media has its own unique characteristics compared to previous research, as it combines IPAS material, digital literacy, interactive features, and the context of Blitar's local wisdom into a single learning product.

This research aims to design an interactive e-comic based on the local wisdom of Blitar on the topic "Plants as a Source of Energy" for fourth-grade students at UPT SDN Minggirsari; to test the validity of the medium through assessments by subject matter experts and media experts, as well as a limited pilot test; and to examine the extent to which the medium is effective in supporting students' digital literacy. The targeted outcome of this research is the availability of digital media that is attractive, accessible, contextual, and aligned with the needs and learning characteristics of elementary school students. From an academic perspective, this research is expected

to enrich the body of knowledge on IPAS media development grounded in local wisdom and digital literacy, while also serving as a reference for educators, school administrators, and future researchers in creating learning innovations relevant to the demands of 21st-century education.

II. Research Methodology

This study employed a Research and Development (R&D) approach based on the ADDIE model, consisting of the analysis, design, development, implementation, and evaluation stages. The resulting product is an interactive e-comic themed around Blitar's local wisdom on the topic of "Plants as a Source of Energy," with the aim of strengthening digital literacy among fourth-grade students at the Minggirsari Public Elementary School (UPT SD Negeri Minggirsari). The ADDIE model was chosen because its stages are systematically organized, thereby facilitating the process of developing, testing, and refining the learning product to meet students' needs and on-site conditions. The development of this digital medium aligns with the findings of Fatih (2023), which show that web-based educational media have been proven to encourage increased student engagement in learning.

Grade 4 at the Minggirsari Public Elementary School (UPT SD Negeri Minggirsari) was designated as the research subject and served as the field test class. The data collected comprised two types: qualitative and quantitative data. Qualitative data was collected through direct observation, in-depth interviews, documentation, and validator input, while quantitative data was sourced from validation questionnaires, feasibility questionnaires, digital literacy questionnaires, and student test results. The instruments used included interview guidelines, observation sheets, documentation, and assessment sheets from subject matter experts, media experts, and language experts, in addition to pre-test and post-test questions. Data analysis was conducted descriptively for both qualitative and quantitative data using percentages, while the effectiveness of the media was tested using a paired-sample t-test to examine the difference in achievement before and after the use of the interactive e-comic. Through this series of procedures, the study is expected to produce learning media that is valid, practical, effective, and capable of supporting students' digital literacy through contextual learning that is closely aligned with the local wisdom of Blitar.

III. Results and Discussion

A. Research Findings

The result of this study is an educational product—an interactive e-comic based on the local wisdom of Blitar, designed specifically for fourth-grade elementary school students. The development process for this educational resource followed the phases of the ADDIE model (analyze, design, development, implementation, evaluation), which the researcher describes in the following explanation:

Analysis (Problem Identification)

During the analysis phase, the researcher explored existing issues through interviews with fourth-grade teachers. The interviews revealed that students' understanding of the topic "Plants as a Source of Energy" remains relatively low, as the teaching methods tend to be monotonous, causing students to become bored quickly, lack confidence, and be unaccustomed to seeking information independently. The teaching materials used were also limited to PowerPoint presentations and textbooks. Based on these findings, there is a need for teaching materials that are more engaging, easier to understand, and capable of supporting students' learning literacy. The curriculum analysis was conducted by reviewing the lesson plans to identify the fourth-grade competency standards and IPAS indicators relevant to this topic.

Table of Learning Outcomes and Elements

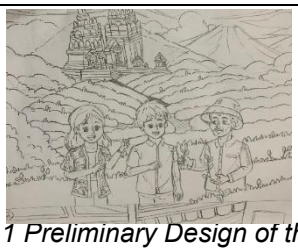
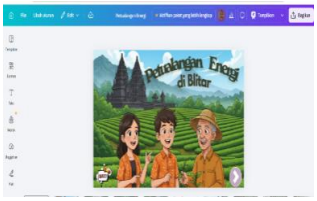
Learning Outcomes	Elements
Melalui media e-comic, peserta didik dapat memahami bahwa tumbuhan merupakan sumber energi bagi makhluk hidup. Peserta didik juga mampu menjelaskan manfaat tumbuhan serta perannya dalam kehidupan sehari-hari dengan cara yang lebih gampang dipahami dan dicerna.	1. Understanding Students are able to: understand that plants serve as a source of energy; explain the uses of plants for the survival of humans and animals; and grasp, in simple terms, the process by which plants produce food. 1. Process Skills Students are able to: examine the illustrations presented in the e-comic; relate the storyline to everyday experiences; retell the content of the e-comic in their own words.

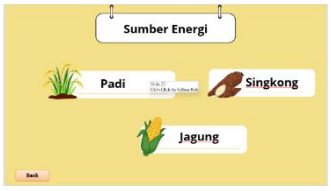
Design (Planning)

After successfully mapping out the learning issues at the school, the researcher proceeded to the planning stage. At this stage, the researcher formulated an innovation design in the form of an interactive e-comic that highlights the local wisdom of Blitar. This planning phase included determining the media format, selecting instructional materials, and developing the e-comic to align with students' needs and expected learning outcomes. This aligns with Nawali's (2024) view, which emphasizes that the development of learning media in MI and SD must be structured to ensure the resulting product is engaging, suited to students' characteristics, and facilitates understanding of the material. This finding aligns with efforts to develop e-comics infused with local wisdom, as learning media are not merely a vehicle for conveying material but also a means of strengthening students' science literacy through regional contexts, storylines, characters, and messages that are familiar to their daily lives.

Design of an Interactive E-Comic Format

The development of interactive e-comics involves several step-by-step processes to ensure the best possible final product. Each step plays a distinct role in creating an e-comic that is engaging, easy to use, and easy for students to understand.

No	Initial Planning	Notes
1.	 *Figure 4.1 Preliminary Design of the Cover (Manual)*	Main Cover Page This panel shows the initial process, which consists of hand-drawn sketches. The researcher outlined the composition of the main character and the background to give it a personal and unique feel.
2.	 *Figure 4.2 Preliminary Cover Design Created in AI*	At this stage, the hand-drawn images are processed using AI technology to apply professional-quality coloring, texturing, and lighting while preserving the original structure of the researcher's hand-drawn sketches.
3.	 E-Comic Interaktif Berbasis Kearifan Lokal Blitar Nama Penulis : Nala Sofia Bariroh Dosen Pembimbing 1 : Ibu Widyarnes Niwangtika M.Pd Dosen Pembimbing 2 : Bapak Mochamad Fatih M.Pd Belajar Bukan Garis Finish, Tapi Petualangan Tanpa Batas. Universitas Nahdlotul Ulama' Blitar *Figure 4.3 Design of the Inside Front Cover*	On the inside cover page, the researcher lists the researcher's name as well as the names of the first and second advisors. This page also includes motivational messages to encourage students to study.
4.	 Kata Pengantar Segala puji bagi Allah, Tuhan Yang Maha Esa atas rahmat dan karuna-Nya, sehingga penulis bisa menyelesaikan E-comic Interaktif ini. Tak lupa juga mengucapkan sholawat serta salam semoga senantiasa tercurahkan kepada Nabi Muhammad SAW, karena berkat beliau kita mampu keluar dari kegelapan menuju jalan yang lebih terang. Kami ucapkan juga rasa terima kasih kepada pihak-pihakyang mendukung lancarnya e-comic interaktif ini mulai dari proses desain hingga proses jadi, yaitu orang tua kami, rekan-rekan kami, penerbit dan masih banyak lagi yang tidak bisa kami sebutkan satu per satu. Adapun E-comic ini disusun untuk membantu pembaca dalam memahami materi IPA dengan cara yang lebih menarik dan menyenangkan. Melalui cerita bergambar, pembaca diajak mengenal bagaimana tumbuhan dapat menjadi sumber energi bagi manusia dan makhluk hidup lainnya. Diharapkan dengan adanya e-comic ini, proses belajar menjadi lebih mudah dipahami dan tidak membosankan. Penulis menyadari bahwa e-comic ini masih memiliki kekurangan. Oleh karena itu, penulis sangat mengharapkan kritik dan saran yang membangun demi perbaikan di masa yang akan datang. Semoga e-comic ini dapat memberikan manfaat, menambah pengetahuan, serta menumbuhkan semangat belajar. Terima kasih. *Figure 4.4 Draft Foreword*	The foreword page contains a carefully crafted passage by the researcher. The foreword begins with expressions of gratitude, words of thanks, and recommendations for using the product.
5.	 Petualangan Energi di Blitar *Figure 4.5 Cover Page Design with a Title*	In the final stage on Canva, the researcher added text elements (speech bubbles), title typography, and interactive buttons. This page is designed so that readers can take actions (such as clicking a button) to continue the story.
6.	 Wah, Beni, kamu tahu tidak kalau tumbuhan (Pa) punya kekuatan luar biasa? Kekuatan apa, Rina? Bisa terbang seperti superhero? *Figure 4.6 Opening Scene Design*	Introducing the main character in a relaxed setting on the porch. Focus on introducing the character before the adventure begins.

7.			Shows the character cycling to Blitar. Left and right navigation buttons have been added here to navigate between pages.
	Figure 4.7 Travel Scene Outline		
8.	Site	 Figurea 4.8 Plan For Kidangan	Location: Kidangan Forest. Click the blue icon to view an explanation about oxygen and photosynthesis.
9.			Masuk ke area kebun teh Sirah Kencong. Menampilkan interaksi dengan warga lokal (petani) untuk menjelaskan energi dari alam.
	Figure 4.9 Site Plan for Sirah Kencong		
10.			Berisi penjelasan jenis tanaman sumber energi (padi, singkong, dll). Ada tombol "Klik Here" agar pembaca bisa eksplorasi info lebih lanjut.
	Figure 4.10 Panel Design		
			
11.			It includes a “Fun Quiz” menu to test readers' understanding. The researcher added a “Let's Go” button as the main navigation button and a “Home” button to return to the main menu.
	Figure 4.11 Quiz Page Design		

Tabel Desain Virtual Reality

Development (*Development*)

The media development phase began with the compilation of materials on energy sources and photosynthesis, aligned with the local wisdom of Blitar, such as the

Kidangan Forest, Sirah Kencong, and Loji. In this phase, the researchers also designed a storyboard to guide the comic's plot, visuals, and narrative. Afterward, they manually sketched the characters and settings to preserve the originality of the designs before proceeding to the digitization process.

Hand-drawn sketches are then converted to a digital format to be colored, textured, and have their resolution enhanced, without altering the original shape of the sketch. After that, the images are processed using Canva to arrange the panel layout, add speech bubbles, and select a typeface that is easy for students to read. In the final step, interactive features are incorporated through hyperlinks and interactive tools provided by Canva, allowing users to navigate pages independently, access additional information via pop-up buttons, and complete evaluation quizzes integrated directly into the media. This development process aligns with the findings of Nasution (2024), which demonstrate that e-comics based on local wisdom can be used to boost elementary school students' science learning outcomes. These findings are relevant to the development of interactive e-comics, given that media relying on stories, visual elements, and narratives can guide students in understanding science concepts through a more engaging approach, making it easier for them to follow the sequence of material, while also connecting the information they learn to the learning context in a more meaningful way.

In addition to validating the instructional materials, this study also examined the quality of the assessment instruments used to measure students' understanding. The instruments were tested for validity and reliability to ensure that each test item could accurately measure the targeted competencies and produce consistent results. The results of the validity tests for each test item are presented in the following table:

Item	Calculated r-value	Table r-value (N=15, α=5%)	Status
S1	0,612	0,514	Valid
S2	0,612	0,514	Valid
S3	0,791	0,514	Valid
S4	0,735	0,514	Valid
S5	0,919	0,514	Valid
S6	0,935	0,514	Valid
S7	0,866	0,514	Valid
S8	0,812	0,514	Valid
S9	0,691	0,514	Valid
S10	0,583	0,514	Valid

Table of Validity and Reliability Test Results

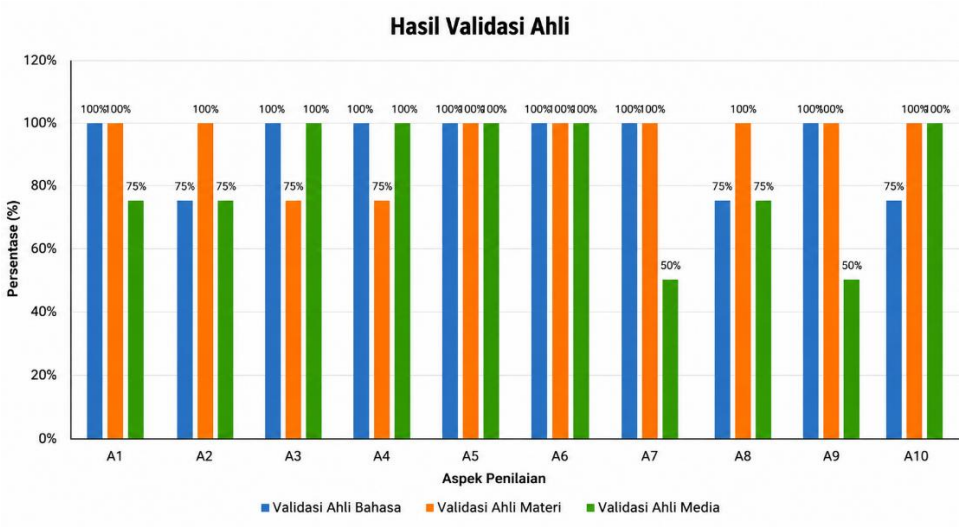
Based on the validity test results, all test items (S1–S10) recorded a value (r_{calculated}) that exceeded (r_{table}) (0.514), with the range of (r_{calculated}) values falling between 0.583 and 0.935. These results indicate that all test items are valid and therefore suitable for use as an evaluation instrument in this study.

Cronbach's Alpha	N of Items
.911	10

Table of Reliability Test Results

Furthermore, the reliability test results shown in Table 4.3 indicate a Cronbach's Alpha value of 0.911 for the 10 test items. This figure exceeds the minimum threshold of 0.70, indicating that the instrument has a very high level of reliability. Based on this, the instrument used can be deemed to meet validity and reliability standards, making it suitable for consistent and accurate measurement of students' learning outcomes.

To ensure that the interactive e-comic media developed meets quality standards, a validation phase was conducted involving three validators: a language expert, a subject matter expert, and a media expert. This process was carried out to evaluate the product's suitability in terms of language, content accuracy, and the quality of the media's presentation and functionality. A summary of the evaluation results from each validator for each indicator is presented in the figure below:



Images of Expert Validation Results

Implementasion (Implementasi)

Product Revision

Once the product has been validated by subject matter experts and media experts, the next step is to evaluate the instructional media. This evaluation process is guided by the suggestions and comments provided by the experts, with the hope that the results will be more effective and beneficial for future research. The following outlines the suggestions and feedback from the experts for refining the product:

a) Linguistic Review

Based on the results of the linguistic validation, the materials that have been compiled still require refinement in terms of language usage—particularly regarding

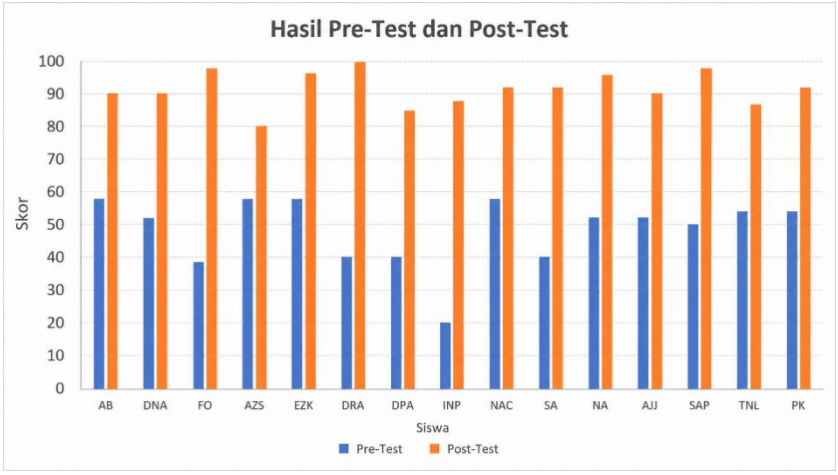
the use of punctuation and capitalization—to ensure they comply with the guidelines for proper Indonesian writing.

b) Subject Matter Expert Review

Based on the results of the subject matter expert validation, the instructional materials that have been developed need to be refined to better align with the Student Worksheets (LKS) being used, so that the content presented is consistent with the learning objectives.

Pre-Test and Post-Test Results

The pre-test, in which 15 students from the Minggirasari Public Elementary School (UPT) in Blitar Regency participated, recorded varying scores out of a maximum of 100. The highest pre-test scores were achieved by AB, AZS, EZK, and NAC, each with a score of 60, while the lowest score was recorded by INP with a score of 20. These findings indicate that students' digital literacy skills prior to the implementation of interactive e-comics based on Blitar's local wisdom were still at a low level, as the majority of students had not reached the maximum score and were still struggling to grasp the material. After the learning process took place using the interactive e-comic media based on Blitar's local wisdom on the topic "Plants as a Source of Energy," a post-test was administered to the same 15 students. The post-test results showed a significant increase in scores, ranging from 80 to 100. The highest score was recorded by DRA with a score of 100, while the lowest score was obtained by AZS with a score of 80. From this comparison, it is evident that the use of interactive e-comics based on Blitar's local wisdom is capable of boosting students' digital literacy, as reflected in the rise in students' scores after the medium was implemented.



Graph of Pre-test and Post-test Results

Once the product was fully implemented, the next step was to measure improvements in digital literacy through pre-tests and post-tests. The pre-test and post-test scores were calculated using the t-test formula, and the results are shown in the table below:

No	Student Name	Pre-Test Score	Post-Test Score	Ideal Score
1	AB	60	90	100
2	DNA	55	90	100
3	FO	38	97	100
4	AZS	60	80	100
5	EZK	60	96	100
6	DRA	40	100	100
7	DPA	40	86	100
8	INP	20	90	100
9	NAC	60	93	100
10	SA	38	94	100
11	NA	54	96	100
12	AJJ	54	89	100
13	SAP	50	98	100
14	TNL	56	87	100
15	PK	55	93	100

Table of Pre-Test and Post-Test Results

From the table, it can be seen that the students' pre-test scores before using the interactive e-comic based on Blitar's local wisdom were still relatively low. The highest pre-test score was 60, while the lowest was 20. The findings in this table align with the picture presented in the graph. After the learning process took place using the interactive e-comic, the post-test scores showed a significant increase, with the highest score reaching 100 and the lowest reaching 80. This indicates that the students' abilities improved after this learning medium was implemented.

	N	Minimum	Maximum	Mean	Std. Deviation
Pre_Test	15	20	60	49.33	11.648
Post_Test	15	80	100	91.93	5.271
Nilai_Ideal	15	100	100	100.00	.000
mean	15	70.00	85.33	80.4222	3.94097
Valid N (listwise)	15				

Table of Average Pre-Test and Post-Test Scores

Based on the previous table, the descriptive analysis shows that the students' average pre-test score was 49.33 with a standard deviation of 11.648. Meanwhile, the average post-test score increased sharply to 91.93 with a standard deviation of 5.271. This surge in the average score indicates that the interactive e-comic medium based on Blitar's local wisdom is capable of guiding students to absorb the learning material more effectively. Furthermore, the lower standard deviation of the post-test results compared to the pre-test shows that students' learning outcomes after using the medium became more evenly distributed among the students.

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	pre_test - post_test	-42.600	13.679	3.532	-50.175	-35.025	-12.062	14	.000

Tabel Paired Sample T-Test

Based on the results of the paired-sample t-test analyzed using IBM SPSS Statistics, the mean difference was found to be -42.600, indicating an increase in scores following the use of interactive e-comics based on Blitar's local wisdom. The calculated t-value was -12.062 with a significance level (Sig., 2-tailed) of 0.000. Since the significance value of 0.000 is below the threshold of 0.05, H_0 is rejected and H_1 is accepted, meaning there is a significant difference between the pre-test and post-test scores. Therefore, the interactive e-comic based on Blitar's local wisdom can be deemed effective in boosting students' learning outcomes and digital literacy.

A. Discussion

Building on previous research and development efforts, this study successfully produced an interactive e-comic based on Blitar's local wisdom on the topic of "Plants as a Source of Energy" for fourth-grade students. This medium was designed to meet the need for science education that is more engaging, contextual, and suited to the characteristics of elementary school students. The use of interactive digital media is considered capable of guiding students in absorbing material more effectively, stimulating their enthusiasm for learning, and encouraging active participation throughout the learning process.

Development of an Interactive E-Comic Incorporating Blitar's Local Wisdom as a Learning Medium

The development of interactive e-comic media incorporating Blitar's local wisdom was carried out using the Research and Development method based on the ADDIE model, which is divided into the analysis, design, development, implementation, and evaluation phases. In the analysis phase, the researchers examined student needs, the curriculum, and student characteristics. The findings indicate that IPAS instruction still makes minimal use of engaging media, causing students to become bored and less enthusiastic about participating in lessons. The developed content aligns with the Merdeka Curriculum on the topic of plants as energy sources for fourth-grade students. Additionally, students' preference for images, stories, colors, and interactive activities served as the basis for selecting e-comics as a learning medium. These findings align with the perspective of Damayanti (2024), who noted that interactive e-comics based on local wisdom have the potential to serve

as an engaging learning medium because they effectively combine visual elements, narrative, interactivity, and local cultural values, thereby making the learning process feel more contextual and easier for students to internalize.

The design phase involves developing the narrative flow, defining the characters, creating a storyboard, designing the visual layout, and selecting the interactive features to be used. This media resource is designed to incorporate elements of Blitar's local culture, such as the surrounding environment, community activities, and examples of local plants. The inclusion of these local elements is intended to help students more easily connect the material to their everyday experiences.

The development phase involves turning the design into an interactive e-comic product using a digital platform. The finished product then undergoes an evaluation process by media experts, subject matter experts, and language experts to assess its suitability. This validation stage is crucial to ensure that the product used in learning is truly accurate in terms of its appearance, content, and language. This aligns with Fatih (2023), who developed an augmented reality-based digital flip book through a similar product development and validation process.

The implementation phase involved directly applying the interactive e-comic medium to fourth-grade classroom instruction. During this phase, students used the medium directly, reading the e-comic content, understanding the material, and completing the prepared exercises. The use of this interactive digital medium made students more enthusiastic, focused, and active throughout the learning process.

The final phase was evaluation, which involved assessing the entire process of developing and using the medium. This evaluation was based on expert validation results, student feedback, and students' learning achievements. Based on these evaluation results, the interactive e-comic based on Blitar's local wisdom was deemed suitable for use as an IPAS learning medium, given its ability to guide students in understanding the material through a more engaging and meaningful approach.

The Validity of Interactive E-Comic Learning Media Based on Local Wisdom from Blitar

The validity of an interactive e-comic based on Blitar's local wisdom, focusing on plants as a source of energy, was assessed through a series of evaluations conducted by media experts, linguists, and subject matter experts. This medium was designed as a form of digital learning innovation that integrates illustrations, narratives, quizzes, navigation buttons, and elements of Blitar's local wisdom, thereby making the learning experience more engaging, interactive, and relevant to students' daily lives. This aligns with Annisa's (2025) perspective, which emphasizes that digital comics rooted in local wisdom have been proven to deepen students' conceptual understanding because they present material in a visual, contextual, and easily digestible manner. Furthermore, this finding is consistent with Fatih's (2022) assertion that visual-based interactive learning media can make learning more engaging while simultaneously facilitating students' understanding. Therefore, the use of visual and

interactive media in learning can help students become more focused, enthusiastic, and better able to grasp the material being taught.

The validation results show that the interactive e-comic medium based on Blitar's local wisdom is suitable for use in fourth-grade IPAS instruction. From a media perspective, the attractive visuals, simple storyline, easy-to-use navigation buttons, and interactive quiz features encourage students to participate more actively in the learning process. From a linguistic perspective, the use of communicative, simple sentences appropriate for the students' developmental level helps them understand the story and material more easily. Meanwhile, from a content perspective, presenting the concept of plants as a source of energy in relation to the environment and Blitar's local wisdom makes it easier for students to connect the material to their daily experiences.

Thus, interactive e-comics based on Blitar's local wisdom not only meet the standards in terms of content, presentation, and language, but also have a tangible impact on students' learning process. The use of this medium has been shown to make students more enthusiastic about participating in lessons, less prone to boredom, more eager to read and answer questions, and quicker to grasp the material being taught. Furthermore, learning becomes more contextual and meaningful, as students can learn the material through examples that are familiar to their immediate surroundings.

The Effectiveness of Interactive E-Comics Based on Blitar's Local Wisdom

The effectiveness of interactive e-comics based on Blitar's local wisdom is reflected in the improvement in students' learning outcomes after this medium was implemented in the classroom. A comparison of pre-test and post-test results revealed that, prior to the use of this medium, students' comprehension of the material was still relatively low. This was evident from the pre-test scores, where the highest score was only 60, while the lowest was 20. These results indicate that most students still struggled to comprehend the material, hesitated when answering questions, and required learning media that was more engaging and easier to understand. This aligns with the findings of Rasyika's (2025) research, which revealed that the use of e-comic media based on local wisdom has a positive impact on the reading literacy skills of elementary school students, as this medium presents content in a visual, contextual, and engaging manner, thereby making it easier for students to absorb the learning material.

After the learning activity using interactive e-comics based on Blitar's local wisdom, students' learning outcomes increased significantly. On the post-test, the highest score achieved was 100, while the lowest was 80. This surge indicates that interactive e-comics can guide students to understand the material more deeply, supported by illustrations, storylines, color schemes, and interactive activities that capture their attention. Additionally, the inclusion of Blitar's local wisdom made the material feel more familiar to students' daily lives, making the concepts easier to grasp and connect to the context of their surrounding environment. The effectiveness of this

medium aligns with the findings of Fatih (2024), which show that technology-based learning media can boost students' science literacy and critical thinking skills.

The results of the descriptive analysis show an increase in students' average scores after using the interactive e-comic. This finding confirms that the developed medium has a significant impact on students' level of understanding. Students who previously struggled found the material more helpful because it was presented visually, coherently, and engagingly. Furthermore, students' abilities after the lesson became more evenly distributed, as evidenced by the post-test results, which showed that nearly all students achieved good learning outcomes..

This improvement in learning outcomes indicates that interactive e-comic media not only serves as a tool for delivering content but is also capable of boosting students' interest, motivation, and engagement. Students became more active in reading, observing images, following the storyline, and grasping the learning messages through this medium.

To examine the significance of the increase in learning outcomes, a paired-sample t-test was conducted using IBM SPSS Statistics. The test yielded a calculated t-value of -12.062 with a p-value of 0.000. Since the p-value of 0.000 is less than 0.05, H_0 is rejected and H_1 is accepted. This indicates a statistically significant difference between the students' pre-test and post-test scores. Based on this, the interactive e-comic medium based on Blitar's local wisdom was found to be effective in improving both the learning outcomes and digital literacy of fourth-grade students at the Minggirsari Public Elementary School (UPT SD Negeri Minggirsari).

Based on these results, the interactive e-comic medium—which draws on Blitar's local wisdom—has had a tangible impact on students: it has helped them understand the material more easily, made them more interested in participating in lessons, encouraged them to be more active in learning activities, and enabled them to achieve significantly higher grades than before. Therefore, this medium can be deemed effective and suitable for enhancing students' understanding, engagement, and digital literacy.

IV. Conclusion

This study successfully produced an interactive e-comic based on Blitar's local wisdom on the topic of "Plants as a Source of Energy," which has been tested and found to be valid, appropriate, and effective in supporting the digital literacy of fourth-grade students at the Minggirsari Public Elementary School (UPT SD Negeri Minggirsari). This medium was developed to address the lack of engaging and contextual learning materials by incorporating local elements of Blitar—such as the natural environment, plantations, and plants found in the students' surroundings—thereby making the science content more tangible and easier to understand. The suitability of this medium was confirmed through an evaluation conducted by media experts, language experts, and subject matter experts, who stated that the visual presentation, design, language, content substance, and available interactive features

met the learning needs of elementary school students. Its effectiveness is reflected in the improvement in students' learning outcomes and digital literacy after using this e-comic, as the medium encourages engagement, independent learning, and the use of technology as a source of information. Thus, this interactive e-comic can serve as an alternative IPAS learning medium that meaningfully integrates technology, instructional content, and local potential.

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