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DEVELOPMENT OF INQUIRY-BASED COMICS WITH REOG TOPICS ON NEWTON'S LAW MATERIAL FOR JUNIOR HIGH SCHOOL STUDENTS AT SMP NEGERI 2 SAMBIT

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ABSTRACT

This research aims to develop an inquiry-based comic with the topic of Reog Ponorogo on Newton's Law material that is feasible, practical, and easy to understand by junior high school students. The type of research used is research and development with the ADDIE model, which is carried out only up to the development stage. Data was obtained through observation, expert validation, teacher response questionnaires, and student readability questionnaires. The data analysis technique uses the Successive Interval (MSI) method to convert ordinal scale data into intervals, then the average is calculated and categorized based on Widoyoko's criteria. The results of the expert validation showed an average score of 22.42 with the excellent category (A). The teacher's practicality assessment obtained a score of 69 out of 80 on the media aspect and 34 out of 40 on the material aspect, both of which are in the very good category. The readability test by 32 students showed results of 83.3% on the visual aspect, 100% on the technical and usage aspect, and 97.5% on the learning aspect. These results show that inquiry-based comics with the topic of Reog are feasible, practical, and have excellent readability so that they can be used as an innovative learning medium that is contextual and supports students' understanding of Newton's Law concepts.

Keywords: inquiry-based comics; Reog Ponorogo; Newton's Law

INTRODUCTION

21st century education presents a wide range of global challenges that demand students to have high-level thinking skills. These skills are an important foundation for students to be able to adapt, innovate, and compete in the midst of complex and dynamic change (Vivekanandan & Pierre-Louis, 2020) The results of the *Trends in International Mathematics and Science Study* (TIMSS) show that Indonesian students are still weak in the aspect of problem solving (Riyadi *et al*., 2021) The low involvement of students in science learning, especially physics, indicates the need for innovative strategies that can increase motivation, understanding, and the connection of materials with real life (Adeoye & Jimoh, 2023)

Physics as a part of science is often considered difficult to understand because it contains many abstract concepts. One of the materials that is considered challenging for junior high school students is Newton's law, which demands the ability to connect the concepts of force, motion, and the interaction of objects. In practice, learning is still dominated by lecture methods and assignments from teachers, so students are less active, and even tend to passively

receive information. This condition makes students' understanding limited, 21st century skills are not optimally developed, and learning motivation decreases (Diniati & & Supratiyoko, 2023) Observations in eight schools showed that although most students were enthusiastic about learning science, about 24% of students still felt little interest because the material was rarely associated with daily life. In addition, almost half of teachers admit that they rarely use innovative media, making it difficult for students to understand abstract concepts. This condition emphasizes the need for contextual, interesting, and relevant learning media for junior high school students.

Previous research has shown that educational comics can increase student engagement and understanding (Nurhakim *et al*., 2024). The integration of local culture in learning is also reported to be able to make learning more contextual and meaningful for students (Fitrianto & Farisi, 2025). However, most of the research still focuses on science topics in general and not many have specifically integrated the process of inquiry structured in comic media, especially in the study of material physics of Newton's Law. In addition, the use of Reog Ponorogo as a cultural context in physics learning has rarely been studied in previous research. Therefore, there is still a gap in the development of learning media that combines comics, inquiry approaches, and local cultural contexts simultaneously. This research seeks to fill this gap through the development of inquiry-based comics with the context of Reog Ponorogo in Newton's Law material.

Learning media plays an important role as a means that can bridge this gap. Media that is innovative and in accordance with the characteristics of students is able to increase engagement, help visualize concepts, and facilitate understanding of the material. One of the media that has been widely developed is educational comics. Comics are able to present abstract concepts in a more concrete way through a combination of text and images, as well as utilizing an interesting storyline (Akcanca, 2020) Previous research has shown that comics can increase motivation, simplify complex material, and help students understand the connections between concepts (Dwiputra *et al*., 2020)(Fitria *et al*., 2023) Comics have been shown to support the development of science literacy (Fitria *et al*., 2023) reduce the cognitive burden on students through simple visualizations (Kristianto *et al*., 2020) and increase students' active involvement in the learning process (Mutia *et al*., 2020) In other words, the use of comics in science learning not only serves as an entertainment medium, but also as an effective pedagogical strategy to improve students' conceptual understanding.

The integration of local culture in learning media not only serves to enrich the content, but also strengthens students' cultural identity. Reog Ponorogo, as one of Indonesia's intangible cultural heritage, has educational value that can be used in science learning (Bekti & Marzuki, 2022). Other research has also shown that Reog performing arts can be used as a relevant educational tool for junior high school students (Fisabilillah *et al*., 2022) By associating physics topics, especially Newton's laws, with Reog's stories and visualizations, students not only learn science but also develop cultural literacy and appreciation for local wisdom. The inquiry approach was chosen because it is able to encourage students to explore, reason, and discover concepts

independently (Gholam, 2019) Additionally, the inquiry model has been shown to be effective in increasing student engagement and building more meaningful understanding (Ambokari & Yermalinda, 2024) Through inquiry, students are encouraged to relate cultural phenomena to the principles of physics so that learning becomes more contextual and meaningful.

Based on the description above, this study aims to develop an inquiry-based comic with the topic of Reog Ponorogo on Newton's Law material. This research is focused on efforts to produce learning media that is feasible, practical, and easy to understand for junior high school students. The integration of local wisdom such as the Dhadak Merak Dance in Reog Ponorogo theoretically contributes by enriching the discourse of physics learning through an ethnoscience approach, identifying the concept of equilibrium and stylistic moments of dance movements to create contextual science education and training students' literacy and creative thinking (Wulansari & Admoko, 2021). Practically, this provides teachers with alternative learning media that connects physics concepts with students' cultural backgrounds, thereby facilitating conceptual understanding and increasing learning engagement (Aryani *et al*., 2025). Thus, the products developed are expected to be able to present learning that is innovative, contextual, and relevant to the needs of the 21st century, while strengthening students' cultural literacy and character.

METHOD

This research uses a type of research and development, which is a process used to produce and validate educational products. The model used is ADDIE which consists of five stages, namely *analysis, design, development, implementation,* and *evaluation* (Cahyadi, 2019) However, in this study, the ADDIE stage was only carried out until the development stage. The data collection method includes observation and questionnaires. Observations were carried out by the researchers to obtain initial information related to learning conditions and the need for learning media in schools. Data collection was conducted at SMP Negeri 2 Sambit. Observations were carried out to obtain initial information related to the need for learning media in the field. Questionnaire instruments in the form of product feasibility validation sheets from experts, product practicality questionnaires from teachers, and student readability questionnaires were used to assess the feasibility, practicality, and readability of the questionnaire-based comics developed. The feasibility evaluation involved two expert validators who are lecturers in science education specializing in science teaching strategies and instructional materials. The validators were selected based on their expertise in science learning and teaching material development. The practicality assessment was conducted by one junior high school science teacher who actively teaches science. The readability test involved 32 eighth-grade students of SMP Negeri 2 Sambit who had previously studied Newton’s Law material. These students represent the target users of the developed comic. The expert validation process was conducted by providing the developed comic along with validation sheets to the validators for assessment. The practicality test was conducted by asking the science teacher to review the comic and complete the practicality questionnaire. The readability test was administered after

students read the comic, followed by filling out the questionnaire under the researcher's guidance. Data analysis in this study was carried out with the following steps. First, all the results of the feasibility assessment from the validator, the practicality of the teacher, and the readability of the students are summarized on each item of the instrument. Furthermore, the ordinal scale data from the questionnaire is converted to the interval scale using the Successive Interval Method (MSI) through the Microsoft Excel add-ins program. The average value of each item is then calculated with the formula:

$$\bar{X} = \frac{\sum x}{n} \quad (1)$$

Information:
X = Average score
$\sum X$ = Total score
n = Number of raters

The average results are then categorized into five criteria, namely very good, good, good enough, not good, and very poor, with reference to score conversion according to (Widoyoko, 2012) as follows:

No	Quantitative Score Range	Value	Category
1	$\bar{X} \geq Xi + 1.8\ Sb_i$	A	Excellent
2	$Xi + 0{,}6\ Sbi < \leq X\bar{X}_i + 1{,}8\ Sbi$	B	Good
3	$X - 0.6\ Sbi < < X\bar{X}_i + 0.6\ Sbi$	C	Pretty Good
4	$X, - 1{,}8\ Sbi < \leq X\bar{X}_i - 0{,}6\ Sbi$	D	Not Good
5	$\bar{X} \leq X - 1.8\ Sbi$	E	Very Bad

Table 1. *Ideal Score Criteria Reference*

Information:
X = Average score
M_I = (ideal maximum score + ideal minimum score)$\frac{1}{2}$
SBi = (ideal maximum score - ideal minimum score)$\frac{1}{6}$

RESULTS AND DISCUSSION

The development of inquiry-based comics in this study uses the ADDIE model which consists of five stages, namely analysis, design, development, implementation, and evaluation. The research is only carried out until the development stage, focusing on needs analysis, comic design, and product feasibility, practicality, and readability tests. The stages of development are explained as follows:

Analysis

The results of preliminary observations show that science learning in some schools still faces challenges, especially related to student interest and involvement. Based on data, around 24% of students stated that they were rarely enthusiastic about learning science, one of which was because teachers rarely related the material to daily life. In addition, most teachers have not taken advantage of creative media that can connect science concepts with local culture. This condition is in line with the findings of Permata & Sandri (Permata & Sandri, 2020) that the problem-solving ability of junior high school students is still low, as well as the research of Khaeruddin et al. (Khaeruddin *et al*., 2023) which shows that students' cultural literacy is not optimal. Therefore, learning media that is innovative, contextual, and able to foster cultural literacy is needed.

The results of this need analysis strengthen the urgency of developing inquiry-based comics with the topic of Reog Ponorogo on Newton's Law material. Comics were chosen because they are able to present abstract concepts through attractive visuals while associating them with local wisdom. Temuan ini sejalan dengan penelitian Tristaningrat (Tristaningrat & Ariyana, 2025) yang menunjukkan bahwa penggunaan komik digital efektif dalam meningkatkan hasil belajar IPA dan sikap ilmiah siswa sekolah dasar, karena mampu memvisualisasikan konsep sains secara lebih konkret dan menarik. However, Tristaningrat's research focuses on improving learning outcomes and scientific attitudes of primary school students without integrating the local cultural context or an explicit inquiry approach. In contrast to the study, the comics developed in this study are designed to be inquiry-based and contain elements of the local culture of Reog Ponorogo, so that it not only serves to improve understanding of physics concepts, but also to foster students' cultural literacy. The integration of inquiry approaches and local cultural contexts is suspected to be a factor that distinguishes the characteristics and potential impact of the developed learning media. The results of this needs analysis are also strengthened by research (Cahyadi, 2019) which states that the analysis stage in the ADDIE model plays an important role in identifying student characteristics, learning problems, and real needs in the field, so that the products developed become more relevant and on target. Therefore, the development of inquiry-based comics that are tailored to the characteristics of junior high school students and the local cultural context is expected to be able to answer the physics learning problems found at the analysis stage.

Design

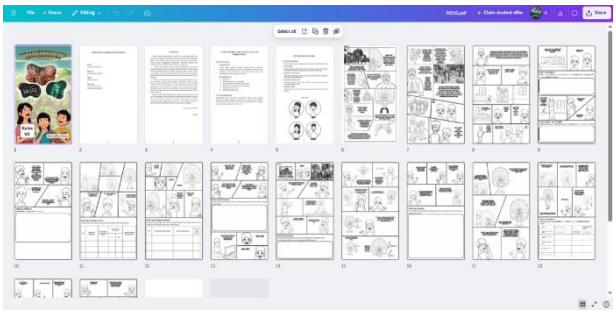


Fig 1. *Comic sketches compiled in Canva*

The comic was designed by integrating Newton's legal concepts into the story associated with Reog Ponorogo's performance. The story is packaged through characters who are close to the lives of junior high school students so that it makes it easier for them to understand the plot. Visualizations are displayed in the form of color images in simple language to match the student's readability level.

The structure of the comic is arranged according to the principles of the preparation of learning media, namely the existence of an introduction, presentation of material, illustration of phenomena, and a simple conclusion (Chu & Toh, 2020) Trigger questions (inquiry) elements are included so that students are encouraged to think critically and find concepts independently. According to Kristianto et al. (Kristianto *et al*., 2020) visual-based learning media such as comics can simplify abstract concepts, increase interest, and support cognitive comprehension. This design is expected to help students understand Newton's legal material contextually while increasing an appreciation of local culture.

The initial draft of a comic or

storyboard was first drawn manually before being developed into digital sketches. The sketch drawing process uses the Procreate software installed on the iPad Pro 2018. The comic arrangement includes the cover section, the author's identity, the foreword, CP-ATP, instructions for using the comic, character introduction, story content, and tasks placed in between the content of the story. After the sketch stage, all the comic components are arranged using the Canva app to produce a neater and more attractive final design.

The research instrument is also designed at this stage to assess the feasibility, practicality, and readability of the comic. The expert validation sheet focuses on aspects of content, presentation, language, and illustrations to assess the suitability of the material, the correctness of the concept, the clarity of the storyline, and the visual quality. The practicality test involved science teachers who assessed the ease of use of comics in learning, the suitability of the content with the curriculum, and its usefulness in increasing student involvement. The readability test was carried out on grade VIII students of SMP Negeri 2 Sambit by reviewing visual aspects, language, concept understanding, and students' interest in comics. The design of this comprehensive instrument ensures that the data obtained can describe the overall feasibility, practicality, and readability of the product.

Develop

Inquiry-based comics on the topic of Reog were declared suitable for use in learning based on the results of the assessment of Science education lecturers. Lecturers as validators assess from the aspects of themes, characters and mandates, background and point of view, language, quality of content and objectives, as well as technical and instructional qualities.

The validation results showed that the

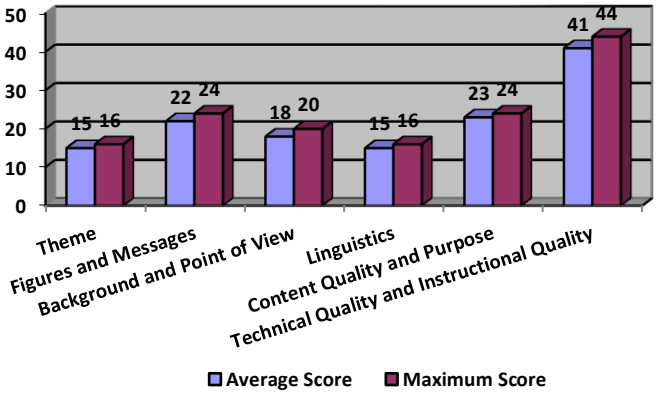


Fig 2. *Results of Feasibility Assessment of Inquiry Comic Products with Reog Topics*

comic obtained an excellent category with an overall average score of 22.42 and an A. Theme, language, and content and objective aspects were assessed according to learning needs, while technical and instructional qualities stood out thanks to the flowing panel flow and communicative illustrations. The cultural integration of Reog Ponorogo is considered relevant to the context of science, and monochrome visualization still supports the readability and understanding of Newton's legal concepts.

Revision of inquiry comic products with Reog topics is carried out based on suggestions and input from expert validators. This revision aims to improve the content, language, and presentation of comics to be more in line with the feasibility standards of learning media. The details of the revisions made can be seen in the following table:

Table 2. *Product Revision Results*

No	Before Revision	After Revision
1	Revision of the title in the preface to ensure consistency with the research focus, learning model, and subject matter presented in this study.	

Kata Pengantar

Puji syukur ke hadirat Tuhan Yang Maha Esa atas segala rahmat dan karunia-Nya sehingga komik berbasis inkuiri yang berjudul "Pengembangan Media Komik Berbasis Inkuiri dengan Topik Reog pada Materi Hukum Newton untuk Meningkatkan Kemampuan Pemecahan Masalah dan Literasi Budaya Siswa SMP" dapat terselesaikan dengan baik.

Komik ini dirancang sebagai media pembelajaran inovatif yang mengintegrasikan konsep-konsep fisika, khususnya Hukum Newton, dengan kearifan lokal Reog Ponorogo. Melalui pendekatan berbasis inkuiri, komik ini diharapkan dapat meningkatkan kemampuan siswa dalam memecahkan masalah ilmiah sekaligus memperkenalkan dan melestarikan warisan budaya Indonesia.

Selain memaparkan penerapan hukum fisika dalam kehidupan sehari-hari, khususnya dalam seni pertunjukan tradisional, komik ini juga bertujuan untuk menumbuhkan rasa cinta dan apresiasi siswa terhadap budaya lokal. Proses pembelajaran yang interaktif melalui media komik diharapkan dapat memberikan pengalaman belajar yang menyenangkan, memicu rasa ingin tahu siswa, serta membantu mereka memahami materi dengan lebih baik.

Semoga komik ini dapat menjadi sarana yang bermanfaat bagi para siswa, guru, dan pembaca dalam meningkatkan kemampuan pemecahan masalah serta literasi budaya. Terima kasih kepada semua pihak yang telah mendukung dalam pengembangan komik ini. Kami berharap komik ini dapat memberikan kontribusi yang positif dalam dunia pendidikan.

Yogyakarta, Oktober2024

Penulis

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Yogyakarta, April 2025

Penulis

2	Minor revisions were made to correct wording and terminology in the learning outcomes and learning objectives flow to ensure clarity and consistency.	

CAPAIAN PEMBELAJARAN DAN ALUR TUJUAN PEMBELAJARAN

Capaian Pembelajaran

- **Pemahaman IPA**

  Peserta didik memahami gerak, gaya dan tekanan, termasuk pesawat sederhana. Peserta didik memahami getaran dan gelombang, pemantulan dan pembiasan cahaya termasuk alat- alat optik sederhana yang sering dimanfaatkan dalam kehidupan sehari-hari.

- **Keterampilan Proses**
  1. Mengamati
  2. Mempertanyakan dan memprediksi
  3. Merencanakan dan melakukan penyelidikan
  4. Memproses, menganalisis data dan informasi
  5. Mengevaluasi dan refleksi
  6. Mengomunikasikan hasil

Alur Tujuan Pembelajaran

Mendiskusikan gaya dan gerak berdasarkan Hukum Newton dengan pemahaman sendiri, melakukan penelitian dan percobaan yang bekerja dengan prinsipHukum Newton dan pemecahan permasalahan sederhana yang terkait dengan kehidupan sehari- hari.

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- **Keterampilan Proses**
  1. Mengamati
  2. Mempertanyakan dan memprediksi
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  5. Mengevaluasi dan refleksi
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Alur Tujuan Pembelajaran

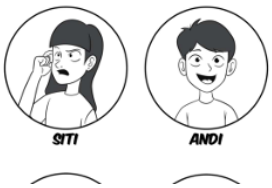
Mendiskusikan gaya dan gerak berdasarkan Hukum Newton dengan pemahaman sendiri, melakukan penelitian dan percobaan yang bekerja dengan prinsip Hukum Newton dan pemecahan permasalahan sederhana yang terkait dengan kehidupan sehari- hari.

3	Editorial revisions and rearrangement of steps in the comic usage instructions

PETUNJUK PENGGUNAAN KOMIK

1. **Scan Barcode di Halaman 1:**
   Mulai dengan memindai barcode di halaman pertama untuk melihat video Reog Ponorogo. Video ini memberi gambaran tentang gerakan Reog yang akan membantu memahami hubungan hukum Newton dalam cerita.
2. **Ikuti Urutan Baca Zigzag:**
   Bacalah dari pojok kiri atas ke kanan setiap baris, hingga selesai di pojok kanan bawah.
3. **Isi Kotak Tugas:**
   Beberapa halaman memiliki Kotak Tugas untuk dijawab. Tugas ini membantu memperdalam pemahaman tentang hukum Newton melalui Reog Ponorogo.
4. **Perhatikan Gambar dan Teks:**
   Setiap panel mengandung penjelasan dan ilustrasi penting. Amati untuk memahami konsep fisika dalam adegan Reog.
5. **Diskusikan Setelah Membaca:**
   Diskusikan bagaimana hukum Newton berlaku pada Reog Ponorogo, untuk memperkuat pemahaman Anda.
6. Nikmati dan Belajar:
   Komik ini tidak hanya menghibur tetapi juga mengajarkan konsep ilmiah. Selamat membaca!

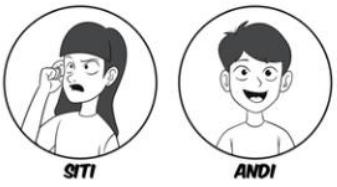
Karakter



PETUNJUK PENGGUNAAN KOMIK

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3. **Perhatikan Gambar dan Teks**
   Setiap panel mengandung penjelasan dan ilustrasi penting. Amati untuk memahami konsep fisika dalam pagelaran Reog.
4. **Diskusikan Setelah Membaca**
   Diskusikan bagaimana hukum Newton berlaku pada Reog Ponorogo, untuk memperkuat pemahaman Anda.
5. **Nikmati dan Belajar**
   Komik ini tidak hanya menghibur tetapi juga mengajarkan konsep ilmiah. Selamat membaca!

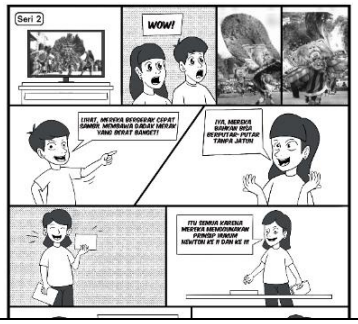
KARAKTER



4	Revision of the comic structure by dividing the content into two series based on conceptual progression of Newton's Law concepts.







A practicality assessment was carried out by science teachers to find out the ease of use of comics in learning. The aspects assessed include materials and media. The results of the assessment showed that the category was very good, with high average scores in both aspects. In the media aspect, comics are considered practical to use because the appearance, design, and technical presentation are according to the needs of the class. In terms of material, the content of comics is relevant to the curriculum, easy to understand, and supports the achievement of science learning goals. Thus, this inquiry-based comic is declared to be practically used as a learning medium. In addition, validators provided several operational recommendations, including organizing the comic into two to three series corresponding to Newton's Laws, structuring the content according to inquiry learning cycles, and incorporating Reog miniatures as supporting learning media.

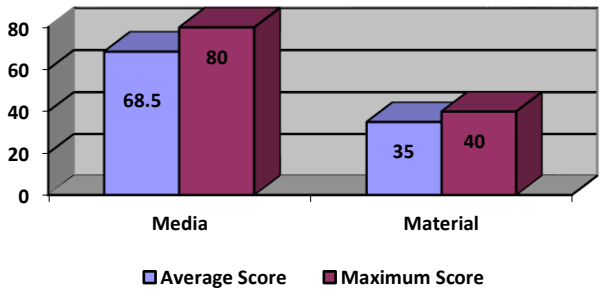


Fig 4. *Results of Practicality Assessment by Science Teachers*

The readability test was carried out by 32 grade VIII students of SMP Negeri 2 Sambit who had studied Newton's Law material. The assessment includes four aspects, namely visual, technical, use, and learning. The results of the questionnaire showed that readability was in the category of very good in all aspects. The visual aspect obtained a score of 83.3%, indicating an attractive appearance and illustrations and supporting material understanding. The technical and usability aspects scored 100%, which means the layout, panel flow, and ease of use are rated very well. The learning aspect reached 97.5%, showing that the content of the comic was relevant and effective in helping the understanding of Newton's Law concepts.

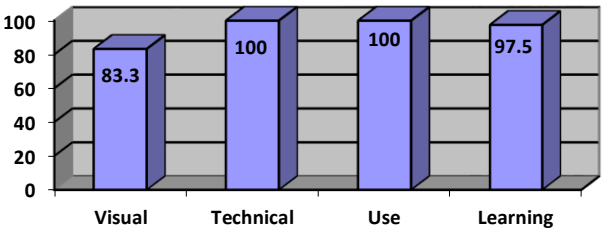


Fig 3. *Results of Assessment of Readability of Inquiry Comics with Reog Topics*

The results of the development stage show that the inquiry-based comic with the topic of Reog Ponorogo on Newton's legal material meets the criteria of feasibility and practicality. These findings are in line with Handayani 's research (2021) which shows that comics are able to facilitate students in understanding abstract concepts through visualization and narrative based on scientific processes. In addition, the study of Pambudi and Suryandari (2025) revealed that the transformation of textbooks into comics is needed by students and teachers to increase engagement and interaction in science learning. Research by Handayani *et al*. (2021) also emphasized that the use of digital comics has proven to be effective in improving students' science literacy and thinking skills, especially in science materials.

CONCLUSION

This research produced an inquiry-based comic with the topic of Reog Ponorogo on Newton's Law material that

was declared feasible, practical, and highly readable. Expert validation showed an average score of 22.42 with an excellent category (A) across the aspects of themes, language, content, and instructional techniques. Practicality assessments by science teachers also indicated a very good category, with an average score of 69 out of 80 on the media aspect and 34 out of 40 on the material aspect. The readability test involving 32 grade VIII students of SMP Negeri 2 Sambit yielded highly positive results, namely 83.3 percent in the visual aspect, 100 percent in the technical and usage aspect, and 97.5 percent in the learning aspect. These findings affirm that the comic can function as an innovative, contextual, and 21st-century-relevant learning medium. Further research is recommended to conduct large-scale trials to measure its empirical effectiveness in improving student learning outcomes. Specifically, future studies may employ a quasi-experimental design with control and experimental groups to examine the effect of inquiry-based comics on students' conceptual understanding of Newton's Laws and higher-order thinking skills. In addition, further development may expand the comic into additional series to cover broader physics topics, and investigate its integration into active learning models such as problem-based learning or project-based learning to enhance student engagement and conceptual mastery.

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