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DEVELOPMENT OF QR-CODE BASED DIGITAL COMICS MULTIMEDIA IN MADRASAH IBTIDAIYAH

PENGEMBANGAN MULTIMEDIA KOMIK DIGITAL BERBASIS QR-CODE DI MADRASAH IBTIDAIYAH

Muhammad Syahru Romadhon[1], Aristhalia Hevi Febrianti[2], Chofifah Dwi Aprilia[3], Samsul Susilawati[4]
[1,2,3,4]UIN Maulana Malik Ibrahim
[1,2,3,4]Jl. Gajayana No. 50 Malang
Email: msyahruromadhon14@gmail.com[1], hevifebrianti155@gmail.com[2], chofifahda11@gmail.com[3], susilawati@pips.uin-malang.ac.id[4]

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Abstract

This study aims to develop QR-code-based digital comic multimedia as a learning media for IPAS on colonialism struggle topics in grade VI madrasah ibtidaiyah. The R&D method utilized the Lee & Owens model, encompassed analysis, design, development, implementation, and evaluation stages. Research instruments included: (1) teacher observation and interview sheets, (2) expert validation sheets, (3) student response questionnaires, and (4) learning outcome tests. Analysis results showed low use of technology-based media in primary schools. The product features interactive digital comics equipped with QR codes that allow access to videos and additional resources. The validation results demonstrate that the developed media is highly appropriate for use and has been proven effective in enhancing student learning outcomes. This media is interesting, interactive, and capable of fostering a spirit of nationalism in students. Development of QR-code-based digital comics can serve as an alternative innovation in IPAS learning, supporting digital transformation in madrasah ibtidaiyah.

Keywords: *IPAS, Digital Comic, Learning Media, QR-Code*

Abstrak

Penelitian ini bertujuan mengembangkan multimedia komik digital berbasis QR-code sebagai media pembelajaran IPAS pada materi perjuangan melawan penjajahan di kelas VI madrasah ibtidaiyah. Metode yang digunakan adalah R&D dengan model Lee & Owens meliputi tahap analysis, design, development, implementation, *dan* evaluation*. Instrumen yang digunakan dalam penelitian ini terdiri atas: (1) lembar observasi dan wawancara guru, (2) lembar validasi ahli, (3) angket respon siswa, dan (4) tes hasil belajar. Hasil analisis menunjukkan rendahnya penggunaan media berbasis teknologi di sekolah dasar. Produk yang dikembangkan menampilkan komik digital interaktif yang dilengkapi dengan QR-code untuk mengakses video dan sumber tambahan. Hasil validasi menunjukkan media yang dikembangkan sangat layak digunakan dan terbukti efektif meningkatkan hasil belajar siswa. Media ini menarik, interaktif, dan mampu menumbuhkan semangat nasionalisme peserta didik. Pengembangan komik digital berbasis QR-code dapat menjadi alternatif inovasi pembelajaran IPAS yang mendukung transformasi digital di madrasah ibtidaiyah.*

Kata Kunci: *IPAS, Komik Digital, Media Pembelajaran, QR-Code*

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1. Introduction

Education in the digital era faces significant challenges, particularly in increasing student interest in the material taught in schools (Anggraini, Harris, & Wahyudi, 2023; Hendriani & Gusteti, 2021). One of the main challenges faced by teachers, particularly in elementary schools, is the limited ability to provide engaging and relevant learning media to meet the needs of a technology-savvy generation (Suttrisno, 2021). Many learning materials presented through lecture methods are still considered boring by students, especially in subjects that rely on lengthy historical narratives, such as Natural and Social Sciences (IPAS) (Pandikar, 2020). This situation is exacerbated by the low appeal of conventional learning media such as textbooks, which tend to be monotonous and less interactive, resulting in students being less motivated to learn (Romadhon, 2024).

One of the subjects that frequently faces this challenge is the history of the struggle against colonialism, taught to 6th-grade students in semester 1. Although this subject is important in instilling the values of patriotism and love for the nation, many students find it less engaging because the presentation is limited to long texts and complex historical narratives (Habibillah, Handini, & Mistofa, 2025). The use of more interactive, visual media that suits the preferences of the digital generation is an important solution to address this challenge. The use of digital media has been shown to increase student learning motivation and provide a more meaningful learning experience (Sugiri, Priatmoko, Amelia, Wibowo, Rahmawati, & Febrianti, 2025).

In this context, QR-code-based digital comics are one innovation that can address this need. Comics, as a visual medium, can simplify complex material and present it in an engaging narrative. The use of comics in learning is not new; research shows that comics can help improve students' understanding of subject matter through easy-to-understand visual narratives (Sianipar, Saprudin, & Zulhalim, 2021). However, the innovation of combining digital comics and QR-Code technology offers additional advantages, allowing students to access multimedia content, such as video, animation, and audio, which supports learning and provides a richer learning experience (Febrianti, 2024; Maryani, 2022; Sianipar, Saprudin, & Zulhalim, 2021).

The use of QR codes enables quick and easy access to supplementary learning content. When students scan a QR code within a digital comic, they can be directed to various multimedia resources that enrich their understanding of historical material, such as historical video recordings, animations of events, or audio narrations from heroes. It not only enhances the appeal of the material but also provides variety in how students access information, thus supporting various learning styles (Rahmawati, 2024). In an increasingly technology-driven educational world, integrating QR codes into learning materials can help create a more personalized and interactive learning experience (Rahmawati, Febrianti, Wibowo, Sugiri, & Kurniawan, 2023).

In addition to the benefits for students, QR-code-based digital comics also offer teachers convenience in delivering materials. Teachers can customize the additional content embedded in the QR code according to the needs of their class and the development of their students (Romadhon, Padil, & Tharaba, 2024). For example, for students who require a deeper understanding, teachers can provide more detailed supporting materials, while for students who understand more quickly, advanced or enrichment materials can be provided (Haris, Alnedral, Taufan, Aulia, & Gusril, 2023). This flexibility allows the learning process to be more adaptive and focused on individual student needs.

However, despite this technology's great potential, its use in elementary school learning in Indonesia is still limited (Sugiri, Priatmoko, Amelia, Wibowo, Rahmawati, & Febrianti, 2025). Research related to the development and implementation of QR-code-based digital comics in formal learning contexts has also been limited, especially at the elementary school level (Hartawan, Dirgayusari, Putri, & Lopez, 2024). Maryani's (2022) research demonstrates that digital comics are effective in increasing students' interest in reading, while Sianipar, Saprudin, & Zulhalim (2021) prove the effectiveness of QR codes in enriching multimedia learning resources. However, most of these studies focus on junior and senior high school levels, examining digital comics and QR-codes separately. No previous research has integrated QR-codes into a unified digital comic medium for IPAS learning in madrasah ibtidaiyah, particularly for thematic content such as the struggle against colonialism. Therefore, this study aims to address this need by developing QR-code-based digital comics as a learning medium in science and science subjects, specifically on the theme of the struggle against colonialism.

This study employed the Research and Development (R&D) method, utilizing the Lee Owens approach, a systematic and structured product development approach. The development process is carried out through several stages, starting from needs analysis, product design, development, product trials, and evaluation and revision. Through this approach, it is hoped that the developed digital comic can meet the criteria of validity, feasibility, and effectiveness in learning.

2. Research method

This research method employs the Research and Development (R&D) type of research, adopting the development model proposed by Lee & Owens. The model is highly suitable for developing learning media or instructional products, as it focuses on systematic and structured development, which can produce valid and effective outcomes. The Lee & Owens model consists of several stages, including assessment/analysis, design, development, implementation, and evaluation. In the first stage, a needs analysis is conducted to understand the problem and formulate development objectives. The design stage then aims to develop the initial concept of the product. After that, the product is developed in the development stage according to the previously designed design. The finished product is then implemented in the implementation stage to obtain feedback from users. In the final stage, namely evaluation, the product is assessed based on its effectiveness and quality, allowing for improvements before it is declared ready for widespread use. This method is considered Appropriate for producing products that meet user needs and can be tested and continuously improved. The following is an illustration of the procedural concept of the Lee & Owens development model:

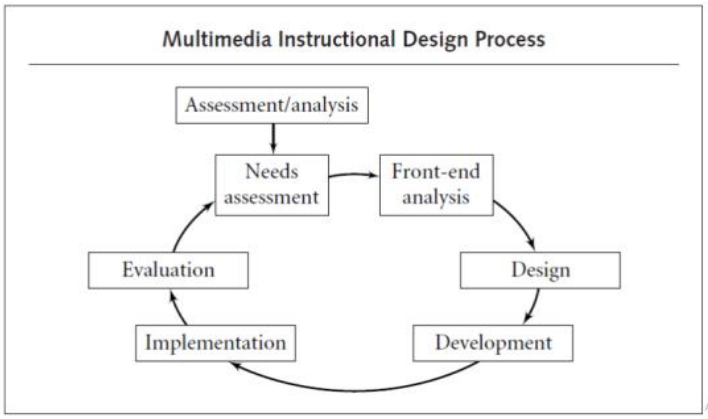


Figure 1. Lee & Owens Development Model Concept

The instruments used in this research consisted of: (1) teacher observation and interview sheets, (2) subject matter expert and media expert validation sheets, (3) student response questionnaires, and (4) learning outcome tests (pretest and posttest). The instrument development process was carried out through consultation with lecturers who are experts in the field of learning technology and basic education to obtain input regarding the suitability of the indicators in relation to the development objectives. This input was used to refine the instruments before their use in the study.

3. Results and Discussion

3.1 Results

Before the implementation phase, all research instruments, including observation sheets, expert review forms, and student response questionnaires, were developed based on theoretical indicators and subsequently reviewed by experts in educational technology and primary education. The feedback obtained from this consultation was used to refine the instruments before being applied in the data collection process.

The result of this development research is a product in the form of a QR-code-based digital comic multimedia containing social studies material on the Indonesian people's struggle against colonialism in Indonesia. The digital comic multimedia was developed using the R&D method by implementing the Lee & Owens development model. The five stages are:

3.1.1 Multimedia Needs Assessment and Analysis

In the first stage, the researcher conducted analysis activities. This analysis was conducted to identify needs and problems in the field. In the initial stage, the researcher conducted a question-and-answer (Q&A) session and observed the learning process. The Q&A session was conducted with sixth-grade teachers at MIN 2 Malang. The results of the Q&A with teachers at MIN 2 Malang indicate that teachers have not fully implemented the use of technology-based learning media. This is due to teachers experiencing limitations in operating technology-based learning media.

Researchers also conducted observations to conduct a needs analysis. Based on classroom observations, teachers tended not to utilize learning media, instead limiting their use of teaching materials. The teaching materials used were also limited to printed

materials on opaque paper. As a result, it made the learning process less engaging and created problems.

Based on empirical data, problems were identified in the learning of science and natural sciences (IPAS) regarding the history of the struggle against colonialism, which is taught in grade 6, semester 1. Although this material is important in instilling the values of patriotism and love for the nation, many students find it less interesting because the presentation is limited to long texts and complex historical narratives. The presentation of the material is also still based on printed teaching materials, which are printed on opaque paper. This condition makes students less enthusiastic about the learning process, and they are often confused by the material provided. Thus, learning media are needed that can have an impact on students, making them more interested in the material on colonialism, and thereby increasing the effectiveness of their learning.

3.1.2 Multimedia Instructional Design

In the second stage, researchers divided the process into three main stages: scheduling media development, determining media objectives, and designing product specifications.

a. Media development scheduling

Media development scheduling is used to ensure the timely completion of media preparation and production. The media development scheduling is presented in table 1.

Table 1. Media Development Scheduling

No	Activity	Implementation Schedule
1	Storyboard Making	First week of October
2	Product Development	Second week of October
3	Validation and revision process	The third and fourth weeks of October
4	Product Implementation	First week of November

b. Determination of learning media achievements

The media used in the learning outcomes are aligned with the school's curriculum. In this case, the school has implemented the merdeka curriculum as part of its learning process. The material used in the research was Indonesian resistance against colonialism in the sixth-grade science subject. The detailed outcomes are presented in table 2.

Table 2. Learning Outcomes

Learning Outcomes (CP)		Learning Objectives (ATP)
At the end of this phase, students will have a deeper understanding of Indonesian culture, history, and the figures and periods they represent, connecting them to the current context. They will also be able to recount the Indonesian nation's struggle against imperialism and its achievement of independence. They will reflect on the	6.2.1	Get to know history, both figures and periods in Indonesia.
	6.2.2	Reflecting the fighting spirit of the heroes and emulating their struggles, which are reflected in real-life actions.

Learning Outcomes (CP)	Learning Objectives (ATP)
fighting spirit of the heroes and emulate their struggles, translating them into concrete actions in their daily lives.	

c. Product specification design

The product specifications in this study were determined by creating a storyboard. Storyboards are created during product design to finalize the product being developed. The storyboards are structured from the initial to the final stages. The media storyboards are presented as follows:

1) The cover storyboard displays the main identity representing the creator's institution and the purpose of the multimedia comic. At the top, there is the logo of UIN Malang, signifying the comic's creator institution. In the center of the page, there is the comic's identity itself, which includes the title and educational level for the target readers. This page is also accompanied by an illustration of a hero, serving as a symbol of the comic's main theme: the struggle of Indonesian national heroes. This level of identity makes it easier for users to identify the target readers.

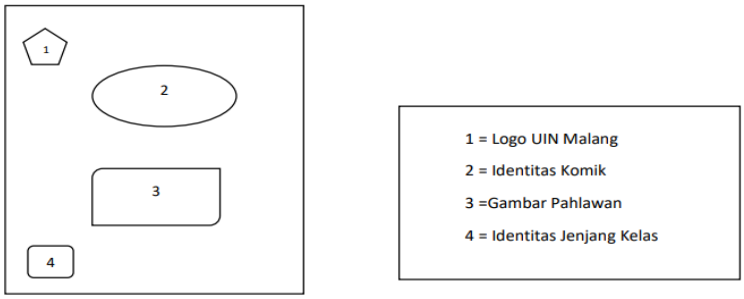


Figure 2. Storyboard Cover

2) In the introductory storyboard, readers are introduced to the comic's main characters: Lina, Budi, and Rian, as well as a teacher who guides them in understanding Indonesia's historical struggles. A map of Indonesia is also included to provide geographic context for the struggle being described. Furthermore, the page provides a scannable QR code to access additional information or related resources about the heroes' backgrounds or the Indonesian history they will be learning about.

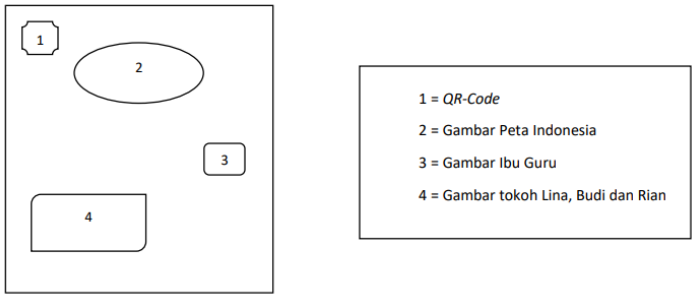


Figure 3. Storyboard of Learning Introduction

3) The media content storyboard chronicles the struggles of various figures in Indonesia. One example is Imam Bonjol, a hero from West Sumatra renowned for his resistance against colonialism. The page features a scannable QR code for access to additional information about Imam Bonjol's struggle. The page title indicates the focus on Imam Bonjol's resistance, and an illustration of the figure serves as the visual center.

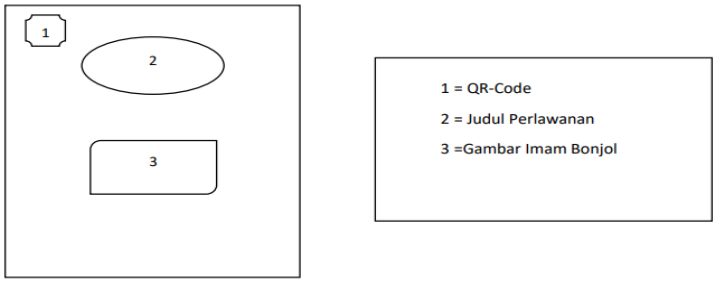


Figure 4. Media Content Storyboard

4) The closing storyboard contains a thank you from the development team to the readers and those who contributed to the creation of this comic. The page also features images of the main characters (Lina, Budi, and Rian), concluding the comic on a note of friendship and warmth, emphasizing the importance of remembering the struggles of Indonesia's heroes.

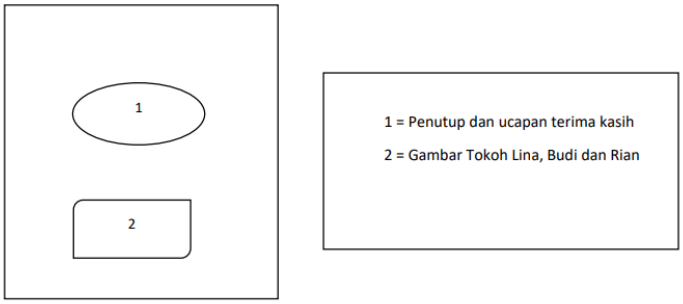


Figure 5. Media cover storyboard

3.1.3 Multimedia Development

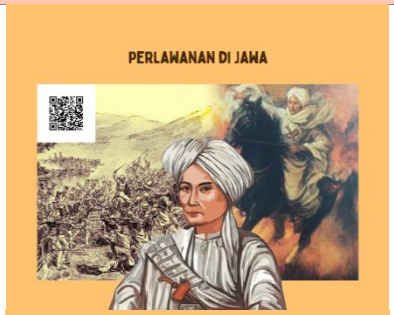
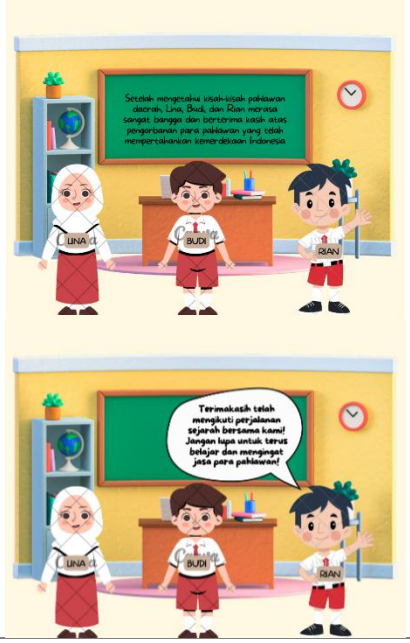
During the development stage, researchers undertake two key activities: product development and product validation.

a. Product Development

At the product development stage, researchers begin to develop products that align with the storyboard that has been developed.

Table 3. Product Development

Picture	Information
	Cover Page The first page of the digital comic displays the creator's primary identity and purpose. At the top is the logo of UIN Malang, the institution that created this. In the center are the title and the target reader's educational level. It features an illustration of a hero depicting the main theme, namely the struggles of Indonesian national heroes. The level identity helps users identify the target audience.
	Initial introduction This page introduces the main characters: Lina, Budi, and Rian, along with a teacher who guides them in understanding the history of Indonesia's struggle. It also features a map of Indonesia for geographic context, as well as a scannable QR code for access to additional information about Indonesian heroes and history.
 	Resistance Material in Maluku This page is a material page compiled by the developer. It tells the story of Pattimura, a hero from the Maluku region. It includes the story title, an illustration of Pattimura, and a QR code for additional information. Through dialogue between Lina, Budi, and Rian, readers are introduced to Pattimura's courage and determination in fighting against colonialism.
	Resistance Material in West Sumatra This page presents the story of Imam Bonjol's struggle against colonialism in West Sumatra. It includes a title, character illustrations, and a QR code for additional information. Through the characters' conversations, readers are invited to understand Imam Bonjol's fighting spirit and crucial role in Indonesian history.

Picture	Information
 	Resistance Material in Java This page chronicles the struggle of Prince Diponegoro of Java against Dutch colonialism. It features titles, character illustrations, and QR codes for additional resources. Through dialogue between the main characters, readers are invited to understand Diponegoro's strategies and sacrifices in his struggle against colonial oppression.
	Closing Page The closing page contains a thank you from the development team to readers and contributors. It features an image of Lina, Budi, and Rian, concluding the story on a friendly note while emphasizing the importance of remembering the struggles of Indonesian heroes.

Picture	Information
	Developer profile and media profile This section features a media developer profile that provides information about the creators of this comic, including their background and the purpose behind developing this educational medium. This information provides readers with additional context regarding the comic's creation process and the strengths of the medium used to convey these inspiring stories.

b. Product Validation

Validation activities are conducted with subject matter experts and media experts. The purpose of validation activities is to assess the product with expert validators before it is implemented.

1) Subject Matter Expert Validator

Table 4. Results of Material Expert Validation

No	Aspect	Evaluation			
		Σ *xi*	**Σ *x***	**P**	**Note:**
1.	Learning objectives are clearly displayed in the learning media.	3	4	75%	Appropriate
2.	The learning objectives align with the material presented.	4	4	100%	Highly Appropriate
3.	The material is delivered clearly.	4	4	100%	Highly Appropriate
4.	The material is delivered coherently.	3	4	75%	Appropriate
5.	The choice of words is Appropriate to the material being presented.	3	4	75%	Appropriate
6.	The material presented in the learning media is useful for students.	4	4	100%	Highly Appropriate
7.	The material can be delivered interestingly.	4	4	100%	Highly Appropriate
8.	The title and content of the learning media are Appropriate.	4	4	100%	Highly Appropriate
9.	Presentation of material can attract students' interest in learning.	4	4	100%	Highly Appropriate
10.	The presentation of material can improve	3	4	75%	Appropriate

No	Aspect	Evaluation			
		Σ xi	**Σ x**	**P**	**Note:**
	students' understanding of the concepts.				
11.	Presentation of material can result in classes not being monotonous	3	4	75%	Appropriate
12.	The learning method used is Appropriate.	3	4	75%	Appropriate
13.	Students can practice directly through activities based on the material in the learning media.	4	4	100%	Highly Appropriate
14.	Multimedia makes it easier for students to learn the material displayed.	4	4	100%	Highly Appropriate
15.	Multimedia can be used as a reference for reflection activities, depending on the material.	3	4	75%	Appropriate
16.	The opening in the learning video includes the delivery of CP and TPA.	4	4	100%	Highly Appropriate
17.	Student-oriented learning media (student-centered)	4	4	100%	Highly Appropriate
18.	The opening, content, and closing of the media are Appropriate and complete.	4	4	100%	Highly Appropriate
19.	The language in the material conforms to the rules of good and correct Indonesian language.	4	4	100%	Highly Appropriate
20.	The language used is interactive and dialogic.	4	4	100%	Highly Appropriate
	Average	73	80	91.25%	Highly Appropriate

Based on the validation results with material experts, a score of 91.25% was obtained. This score falls within the Highly Appropriate category, indicating that the media material is suitable for use by students in the learning process.

2) Media Expert Validator

Table 5. Media Expert Validation Results

No	Aspect	Evaluation			
		Σ *xi*	**Σ *x***	**P**	**Note:**
1.	There is a creator identity in the product.	4	4	100%	Highly Appropriate
2.	The product includes the identity of the institution from which the developer originated.	4	4	100%	Highly Appropriate
3.	An official logo accompanies the institution's identity.	4	4	100%	Highly Appropriate
4.	The product includes instructions for use that can make it easier for users.	2	4	50%	Marginally Appropriate
5.	The product title employs standard and attractive sentence structure.	3	4	75%	Appropriate
6.	The choice of font can attract interest.	4	4	100%	Highly Appropriate
7.	The size of the letters used can meet the readability aspect for users.	3	4	75%	Appropriate
8.	The color combination used can attract user interest.	3	4	75%	Appropriate
9.	The layout arrangement and variation of images with fonts can enhance the readability element.	4	4	100%	Highly Appropriate
10.	The product presents supporting images that are relevant to the discussion of the material.	4	4	100%	Highly Appropriate
11.	The presentation of images is in accordance with the material explained in *the QR-code-based digital comic media.*	4	4	100%	Highly Appropriate
12.	The narrative conveyed in the media is clear and easy to understand.	4	4	100%	Highly Appropriate
13.	*QR-code*-based digital	4	4	100%	Highly

No	Aspect	Evaluation			
		Σ *xi*	**Σ *x***	**P**	**Note:**
	comic media is clear and easy to read.				Appropriate
14.	The clarity of the narrator's voice in conveying the material in *the QR-code video is audible*.	4	4	100%	Highly Appropriate
15.	*QR-Code*-based digital comic media has good quality when played on gadgets.	4	4	100%	Highly Appropriate
16.	The product is suitable for delivering learning materials.	3	4	75%	Appropriate
17.	*QR-code*-based digital comic media is relevant to the material that will be delivered to students.	4	4	100%	Highly Appropriate
18.	The product is believed to enhance student learning outcomes.	3	4	75%	Appropriate
19.	*QR-Code*-based digital comic media can be operated smoothly.	3	4	75%	Appropriate
20.	The product has adequate mobility elements (easy to carry).	4	4	100%	Highly Appropriate
	Average	72	80	90%	Highly Appropriate

Based on validation results with media experts, a score of 90% was obtained. This score is considered Highly Appropriate, indicating that the media is suitable and can be used by students in the learning process.

3.1.4 Multimedia Implementation

After the product development and validation activities, the researcher continued to the next stage, namely the implementation stage of the learning media. The implementation of the learning media was carried out in class VI of MIN 2 Malang. The purpose of the implementation stage was to gather user responses regarding the learning media and assess the effectiveness of the product.

The first activity undertaken by the researcher was a pretest. Twenty questions were administered. The pretest was designed to assess students' initial understanding of the historical material. The purpose of the pretest was to determine students' initial understanding and adapt the learning media.

Media implementation activities were carried out easily during the learning process. During the study, students did not appear to have any difficulty using the learning media. This aligns with the opinion that interactive multimedia in the learning process can facilitate learning, allowing students to access it anytime, anywhere, without time constraints.

3.1.5 Multimedia Evaluation

The evaluation was conducted to analyze the product validation results from design and material expert validators, as well as the product's attractiveness level obtained from the questionnaire and its effectiveness, as reviewed from the student's pretest and posttest results. The evaluation phase was carried out to assess the product's feasibility in achieving its objectives. The evaluation results served as a reference for revision activities, ensuring that the teaching materials were truly effective and aligned with expectations.

3.2 Discussion

The needs analysis stage was conducted through observations and interviews with sixth-grade teachers at MIN 2 Malang. The analysis revealed that the use of technology-based learning media remains limited, with teachers primarily relying on simple printed teaching materials. This condition has led to low student interest in understanding the nation's history of struggle. These results align with the opinions of Saripudin, Komalasari, & Anggraini (2021) and Suttrisno (2021), who note that the challenge of education in the digital era is the lack of innovative media that engages students. Therefore, more interactive and contextual learning media are needed to increase learning motivation.

The analysis phase also identified that the science and science material on the theme of the struggle against colonialism requires a visual narrative approach to facilitate understanding by elementary school students. This aligns with Maryani (2022) findings, which confirm that comics are effective in presenting historical material through illustrated narratives, facilitating conceptual understanding.

In the design stage, researchers determined CP and ATP based on the independent curriculum, specifically so that students can recognize the history, figures, and spirit of the nation's struggle, as well as emulate their values in everyday life. This stage demonstrates the integration between instructional design and the character goals to be achieved, as suggested by those who argue that history learning in elementary schools must be oriented towards the formation of a character with a love for the homeland.

In addition to determining the objectives, this stage also produces storyboards as an initial product design. Each storyboard depicts visual and textual elements, ranging from the cover page and character introductions to the content on the struggles of Pattimura, Imam Bonjol, and Prince Diponegoro, and concluding with the conclusion. This design exemplifies the application of multimedia learning principles, where text, images, and visual symbols are integrated to enhance understanding (Sugiri, Priatmoko, Amelia, Wibowo, Rahmawati, & Febrianti, 2025).

The development phase involved transforming the storyboard into an interactive digital comic using QR codes. The integration of QR codes enables students to access videos, audio narratives, and additional resources directly. This innovation has been proven to enrich the learning experience and increase student independence in finding

information, consistent with research by Erica (2021) and Rahmawati, Nisa, Astuti, Fajariyani, & Suliyanti (2022) which found that QR-codes can expand access to multimedia-based learning.

The validation results from the material experts showed a score of 91.25% (highly appropriate), while the validation results from the media experts obtained a score of 90% (also highly appropriate). These high scores indicate that the media content and display are in accordance with pedagogical, aesthetic, and functional principles (Faizah, Faizah, Romadhon, & Widayanti, 2023; Lufthansa, Saputro, Rohmah, Yusuf, & Artanty, 2022), as well as student-centered learning (Romadhon, 2024).

The implementation was carried out in class VI of MIN 2 Malang. Students used digital comics in their science learning activities, and observations showed that they were enthusiastic and able to operate the media easily. This finding is consistent with the finding that QR-code-based learning media increases students' motivation and active participation, as noted by Widyastuti & Syahputra (2024), who also found that QR-code-based learning increases motivation and participation in the learning process. The pretest and posttest results showed a significant increase, with an n-gain value of 0.704 (indicating a high category). This means that QR-code-based digital comics are effective in improving the learning outcomes related to the nation's history of struggle. This suggests that visualizing hero figures through illustrated stories can enhance students' memory retention and conceptual understanding.

The evaluation phase was conducted to assess the effectiveness, attractiveness, and feasibility of the product based on expert validation, student response questionnaires, and learning outcomes. Based on the evaluation results, the QR-code-based digital comic was declared highly feasible and effective as a learning medium for science. This evaluation also confirmed that the use of interactive technology can overcome the limitations of conventional media and create meaningful learning experiences (Ema, Marno, & Yaqin, 2024).

Overall, the research results indicate that the development of a QR-code-based digital comic successfully met the criteria of validity, practicality, and effectiveness in science learning. This product not only improved students' understanding of history but also fostered patriotism and a sense of national spirit. The findings of this study support previous research by Sugiri, Priatmoko, Amelia, Wibowo, Rahmawati, & Febrianti (2025), which emphasized that integrating digital media can increase student engagement and learning outcomes. This study reinforces those findings by demonstrating similar effectiveness within the context of IPAS learning in madrasah ibtidaiyah, showing that QR-code-based digital comics can serve as a practical and interactive medium for integrating technology into elementary education (Romadhon, Irawan, & Abdussakir, 2025). These results confirm that integrating technology into learning media is a strategic and feasible step toward adaptive and innovative basic education in the digital era.

4. Conclusion

QR-code-based digital comics have been successfully developed using the Lee & Owens R&D model method and have proven to be highly feasible, engaging, and effective in improving history learning through the interactive content and visualization of stories about struggle figures. The prospects for developing this media are very

broad; it can be expanded to various other subjects, enhanced with interactivity features with gamification or integration into LMS, even using Augmented Reality (AR) technology for a more immersive experience. For further research, it is recommended to conduct a comprehensive comparative analysis across various schools, examining the specific impact on critical thinking skills and learning motivation, testing the long-term effectiveness on memory retention, and conducting a cost-benefit analysis to provide more comprehensive policy recommendations.

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