



Development of an e-comic media assisted by QuiverVision for integrated literacy learning

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Abstract

This study was motivated by the low reading and writing literacy of third-grade students at SDS Terpadu Bani Rauf Gowa, Indonesia, shown by students' limited ability to comprehend texts, identify main ideas, interpret information, and organize ideas coherently in writing. Learning that still relies on lecturing and conventional media has resulted in low student interest, motivation, and involvement in literacy activities. This study aimed to (1) describe the need for QuiverVision-assisted e-comic media, (2) develop the media based on an integrated literacy learning approach, (3) determine the validity of the media, (4) determine the practicality of the media, and (5) determine the effectiveness of the media in improving the reading and writing literacy of third-grade students. This research employed a research and development (R&D) method using the ADDIE model, consisting of the analysis, design, development, implementation, and evaluation stages. The participants were one classroom teacher and 30 third-grade students of SDS Terpadu Bani Rauf Gowa. Data were collected through observation, needs-analysis questionnaires, expert validation sheets, teacher and student response questionnaires, and reading-writing literacy tests (pretest and posttest), and were analyzed descriptively and quantitatively. The results show that the QuiverVision-assisted e-comic media was successfully developed according to the identified learning needs. We successfully developed an e-comic that stimulates students' reading and writing literacy through several integrated activities, including reading illustrated stories, identifying characters and main ideas, answering comprehension questions, observing augmented-reality visualizations, and rewriting the story in their own words. Expert validation produced scores of 91% from the material expert, 88% from the media expert, and 84% from the language expert, indicating that the media was valid to strongly valid. Teacher and student response scores reached 90.00% and 79.88%, respectively, with an average practicality score of 84.94%, categorized as very practical. The effectiveness test showed an increase in students' mean score from 35.87 on the pretest to 82.67 on the posttest, a statistically significant paired-sample t-test result, and an N-Gain value of 0.64 in the moderate category. These findings indicate that the developed media is valid, very practical, and effective for use in Indonesian language learning to improve elementary students' reading and writing literacy. This study contributes to the advancement of language education by providing an innovative and alternative literacy learning medium that integrates digital storytelling, visual interaction, and augmented reality technology in a single instructional process, thereby supporting more engaging and meaningful reading and writing learning activities for elementary school students.

Keywords: augmented reality, e-comic, integrated literacy, QuiverVision, reading and writing literacy

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INTRODUCTION

Learning Indonesian in the third grade is ideally directed at developing reading and writing literacy as the main foundation for students' success in learning other subjects, since early

literacy is widely regarded as an important indicator of long-term academic achievement (Nadda et al., 2025; Maritim, 2023). Students are expected to be able to understand information in a text, interpret the content of what they read, and pour ideas back out coherently in writing, as reading and writing skills are expected to develop in an integrated manner in the third grade (Malpique et al., 2022).

This ideal condition, however, has not been fully achieved in many schools, including at SDS Terpadu Bani Rauf Gowa, where third-grade students should already be at the stage of fluent reading and structured writing. Preliminary observation showed that students' reading comprehension was still low, as seen from their difficulty in determining the main idea of a text and their low confidence in answering questions related to the content they had read. Students' writing skills were also constrained, since they had difficulty composing paragraphs, choosing appropriate vocabulary, and developing a story line. These difficulties were compounded by low reading interest, as students quickly grew bored with learning media that were considered unattractive and with teaching methods that tended to be monotonous.

A needs-analysis questionnaire distributed to the third-grade students confirmed this picture. Regarding difficulty in understanding material from textbooks, 50% of students disagreed and 46.7% agreed that conventional media had been sufficient, indicating that most students felt conventional media had not been fully helpful. Regarding the need for more attractive learning media, 50% strongly agreed and 43.3% agreed, indicating a high need for interactive visual media. Interest in e-comics was also high, with 50% of students strongly agreeing and 40% agreeing that they enjoyed reading stories in the form of colorful, clearly illustrated e-comics. In terms of comprehension, 53.3% of students strongly agreed and 40% agreed that e-comics made it easier for them to understand story content through a combination of text and interesting illustrations, while 66.7% strongly agreed that the attractive appearance of e-comics helped them stay focused during learning.

Teachers had attempted various approaches to improve students' literacy, such as using storybooks, worksheets, or shared reading activities in class, but these approaches were not fully effective because the media used did not present visualizations capable of attracting students' interest. Students tend to respond more actively to interactive visual media than to plain text, so that conventional approaches often fail to foster their attention and curiosity (Mayer, 2021). Comics, in particular, possess a strong visual character that helps students understand a story more easily through a sequence of pictures and simple text, and have been reported to support literacy learning in elementary schools (Eisner, 2021; Graham & Hebert, 2021; Guthrie & Wigfield, 2000; McCloud, 2020; Khotimah, Ratnawuri, & Pritandhari, 2021; Mahayani et al., 2024).

QuiverVision is an application that enables users to transform two-dimensional pictures into interactive three-dimensional visualizations through augmented reality (AR) technology (Alfian et al., 2022). The application is usually installed on Android or iOS smartphones and tablets and is used by scanning images or markers using the device camera. QuiverVision provides various features such as 3D animation, object movement, color interaction, sound effects, and real-time visualization, which make learning activities more engaging and interactive.

The use of comics alone, however, is not yet fully optimal if it is not equipped with technology that can bring the story to life (Nurchurifiani & Zulianti, 2021). Combining e-comics with augmented reality (AR) technology through the QuiverVision application is a superior option, since two-dimensional images in the e-comic can appear as interactive three-dimensional animations when scanned with a digital device. AR technology of this kind offers a more immersive learning experience, allowing students to see scenes come alive in detail, which encourages them to understand the plot, characters, and setting more easily, and to write about what they observe (Azuma, 2021; Kloss, 2022). In this way, the media is expected not only to strengthen reading literacy, but also students' writing skills at the same time.

Previous studies on comic-based and augmented-reality-based learning media have generally examined the two components separately, focusing either on reading comprehension or on the general use of digital media, without deliberately combining an interactive AR-based visual comic with an integrated reading-writing literacy activity for third-grade students (Widianto et al., 2024; Yulaichah, Mariana, & Wirayanto, 2020; Azuma, 2021). This gap indicates that the development of a learning medium that combines an e-comic with augmented-reality technology to improve integrated reading and writing literacy among third-grade elementary students remains limited. Based on this background, the novelty of this study lies in the integration of a digital story-based visual medium (e-comic) with an interactive three-dimensional-animation feature through the QuiverVision application, so that the medium not only presents material attractively but also provides a more concrete and meaningful learning experience that unites reading and writing activities within a single integrated-literacy learning process.

Based on the problems and potential described above, this study was directed at answering the following questions: (1) what are the learning needs for an e-comic media assisted by the QuiverVision application for third-grade Indonesian language learning; (2) how is the media designed and developed; (3) what is the level of validity of the media based on the assessment of material and media experts; (4) what is the level of practicality of the media based on teacher and student responses in a limited trial; and (5) what is the level of effectiveness of the media in improving the reading and writing literacy of third-grade students. In line with these questions, this study aimed to describe the learning needs, develop the e-comic media assisted by QuiverVision, and determine its validity, practicality, and effectiveness in improving reading and writing literacy among third-grade elementary school students.

RESEARCH METHOD

This study used a research and development (R&D) approach, which is a process used to develop and evaluate educational products (Borg & Gall, 1983). The product developed was an e-comic learning media assisted by the QuiverVision application, intended to improve the reading and writing literacy of third-grade elementary school students. The development model used was the ADDIE model developed by Branch (2009), consisting of five systematic and interrelated stages: Analysis, Design, Development, Implementation, and Evaluation. This model was chosen because it allows revision at every step, so that the resulting product becomes more optimal, valid, and effective for classroom use, and because it is considered suitable for developing technology-based learning media such as an AR-assisted e-comic.

The study was conducted at SDS Terpadu Bani Rauf Gowa, a school selected based on preliminary observation showing that students' reading and writing literacy still needed improvement and that technology-based learning media were still limited. The research was carried out over approximately three months, covering preparation and needs analysis, media development and expert validation, and field implementation together with data analysis and reporting.

Research procedure

The development procedure followed the five stages of the ADDIE model, namely Analysis, Design, Development, Implementation, and Evaluation, as illustrated in Figure 1.

Analysis

The analysis stage was conducted to identify learning needs, student characteristics, and classroom conditions through observation, interviews, and questionnaires administered to the teacher and students of the third grade. The results indicated that the teacher still relied mainly on printed textbooks, that technology-based media use was limited, and that students were more interested in visual media in the form of pictures and stories than in text-only material.

The core competencies of third-grade Indonesian language related to reading and writing literacy were then analyzed to determine the content of the media.

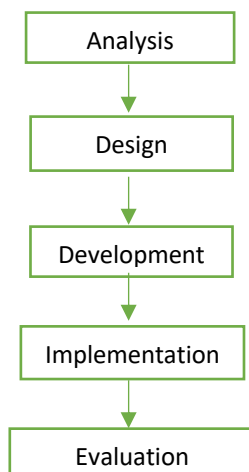


Figure 1. ADDIE research procedure flowchart

Design

We designed "*Petualangan Buku Ajaib*" (the adventure of the magic book) about a child character who discovers a magic book and enters the world of literacy. The e-comic structure consisted of a cover page, instructions for use, character introduction, story content (reading material), a moral message, and a closing section. The application Canva was used to design the visual layout, and the media was integrated with the QuiverVision application to provide an augmented-reality feature that allows students to interact with objects virtually.

Development

The initial e-comic product was validated by media, material, and language experts and by a practicing teacher. The media-expert validation assessed the feasibility of the display, design, and technical aspects; the material-expert validation assessed the suitability of content, concept accuracy, and achievement of learning objectives; the language-expert validation assessed the use of clear, communicative language appropriate to elementary students; and the practitioner validation assessed the applicability of the product in classroom learning. Feedback from the validators was used as the basis for the first revision of the design, content, and language of the media before it was tested with students.

Implementation

The revised media was tested in a small-group trial involving 10 third-grade students to examine readability, ease of use, and initial student response, followed by a field trial involving all 30 third-grade students of SDS Terpadu Bani Rauf Gowa. During the field trial, the teacher and students used the e-comic media assisted by QuiverVision in the learning process, and students provided responses through a prepared questionnaire, while the researcher observed student activity and engagement.

Evaluation

We evaluated the product using $O^1 \times O^2$ design, in which O^1 is the pretest, X is the treatment using the e-comic media, and O^2 is the posttest. A multiple-choice and essay test on reading and writing literacy was administered before and after the use of the media in the experiment class.

Participants and data collection

The subjects of this study were the third-grade teacher and 30 third-grade students of SDS Terpadu Bani Rauf Gowa. Data were collected through (1) observation of classroom conditions,

teacher activity, and student engagement; (2) an interview with the classroom teacher to identify learning needs and problems; (3) questionnaires for expert validation and for teacher and student responses regarding the practicality of the media, using a Likert scale; and (4) reading and writing literacy tests, consisting of a reading-comprehension test and a narrative-writing performance test assessed with a scoring rubric, administered as a pretest and posttest. Documentation of learning activities and test results was also collected to support the findings.

Data analysis technique

Data were analyzed descriptively for qualitative data (observations, interviews, and validators' comments and suggestions) and quantitatively for validity, practicality, and effectiveness data. The validity of the media was analyzed based on experts' scores using a Likert scale, converted into a percentage using the formula stated in Equation (1).

$$P = \frac{F}{N} \times 100\% \quad (1)$$

where F is the total score obtained and N is the maximum possible score. The percentage was then categorized as strongly valid (81-100%), valid (61-80%), fairly valid (41-60%), less valid (21-40%), or invalid (0-20%). The practicality of the media was analyzed from teacher and student response questionnaires using the same formula, with results categorized as very practical (81-100%), practical (61-80%), fairly practical (41-60%), less practical (21-40%), or not practical (0-20%). The media was considered practical if it achieved at least the "practical" category.

The effectiveness of the media was analyzed from students' pretest and posttest scores. A normality test (Kolmogorov-Smirnov) and a homogeneity test (Levene's test) were conducted using IBM SPSS Statistics version 25.0 for Windows to confirm that the data were normally distributed and had homogeneous variance (significance value > 0.05). A paired-sample t-test was then conducted to determine whether there was a significant difference between the pretest and posttest scores, with the criterion that a significance value below 0.05 indicates a significant effect of the media on students' reading and writing literacy. In addition, the improvement in students' scores was analyzed using the normalized gain (N-Gain) formula, as stated in Equation (2).

$$g = \frac{S_{posttest} - S_{pretest}}{S_{max} - S_{pretest}} \quad (2)$$

where g is the N-Gain value, $S_{posttest}$ is the posttest score, $S_{pretest}$ is the pretest score, and S_{max} is the maximum attainable score. The resulting gain score was categorized as high ($g \geq 0.7$), moderate ($0.3 \leq g < 0.7$), or low ($g < 0.3$).

RESULTS AND DISCUSSION

Results

The needs-analysis questionnaire distributed to the teacher and students showed a similar pattern (See Table 1). From the teacher's questionnaire, the availability of appropriate media reached only 70%, while the perceived need for a more attractive medium reached 90%, and the desired characteristics of such a medium reached 92%; meanwhile, students' reading and writing literacy were both rated at only 58-60%. The students' own questionnaire produced a comparable pattern, with the availability of media at 65%, desired characteristics of the medium at 88%, need for the medium at 85%, and reading and writing ability both at 58-60%. These results indicate that Indonesian language learning in the third grade still requires a more attractive, interactive medium suited to students' characteristics, which formed the basis for developing the e-comic media assisted by QuiverVision.

Table 1. Need analysis results

No	Aspect	Teacher's responses (%)	Students' responses (%)
1	Availability of learning media	70%	65%
2	Expected media characteristics	92%	88%
3	Need for learning media	90%	85%
4	Students' reading literacy	60%	60%
5	Students' writing literacy	58%	58%

Media design and development

The e-comic media was developed through five stages: (1) preparation stage, in which supporting tools and relevant reading-writing material were identified; (2) a content-design stage, in which the structure of the e-comic (introduction, character introduction, story content, learning activities, and evaluation) was designed with a simple narrative, illustrations, and reading-comprehension activities; (3) a development stage, in which the material was produced as an e-comic incorporating text, images, and interactive AR elements through QuiverVision, together with comprehension questions and writing exercises; (4) an integration and refinement stage, in which the content, appearance, story flow, readability, and integration between the e-comic and the QuiverVision application were checked and revised; and (5) a finalization stage, producing an interactive, contextual e-comic media ready to be validated and trialed.

The development process resulted in an integrated literacy-based e-comic consisting of several instructional features, including a cover page, character introduction, illustrated stories, reading activities, writing activities, evaluation exercises, and augmented reality (AR) visualization through the QuiverVision application. These features were designed to facilitate students in developing reading comprehension and writing skills through meaningful, interactive, and technology-supported learning experiences. The main features of the developed e-comic are presented as follows.



The harmony adventure of
animals

Figure 2. Cover page

The cover page presents the title of the e-comic together with colourful illustrations that attract students' attention before beginning the learning activities (See Figure 2). The visual design was intentionally created to increase students' curiosity and motivation to participate in reading and writing activities.



Introducing characters
Penguin
Rabbit
Sheep

Figure 3. Introduction to the comic characters

This page introduces the main characters, name penguin, Rabbi, and Sheep (See Figure 3). The introduction of the characters helps students recognize the roles of each character throughout the story and encourages emotional engagement with the learning content.



Figure 4. Illustrated story page

Sheep: Oh no, the plants are wilting and the river water is muddy! Something is wrong.
Rabbit: This place used to be very beautiful, but now it looks like this.
Sheep: Let us find out what caused it.
Rabbit: There is garbage being thrown into the river. That is the cause.
Penguin: There are also dangerous substances damaging the plants.
Penguin: This is the result of irresponsible human behavior. We must fix it.

The illustrated story (See Figure 4) serves as the core learning material. The story combines simple dialogues with colourful illustrations to improve students' reading comprehension while introducing environmental conservation values.



Figure 5. Story section illustrating environmental problems.

Sheep: We must clean the garbage and the river water.
Rabbit: But we need help and a good plan.
Penguin: Let us gather all the animals in the forest to help.
Sheep: Our environment is damaged. This is our shared home, and we must help repair it.
Forest animals: We are ready to help! We want the environment to become beautiful again.
Penguin: Thank you! With cooperation, we can do it.
Sheep: Cooperation makes the work easier and faster.
Rabbit: Look! Many places are already clean.
Penguin: Keep up the spirit! We can finish it.
Sheep: Look! Our environment has become beautiful and fresh again.
Rabbit: Thanks to everyone's cooperation, we succeeded in restoring it.
Penguin: Keeping the environment clean is the responsibility of all of us.

This section presents environmental problems encountered by the characters (See Figure 5). Students are encouraged to identify the main ideas, understand the sequence of events, and discuss possible solutions based on the story.

Validity of the media

The developed media was validated by media, material, and language experts before being trialed with students. Table 1 presents a summary of the validation results.

Table 1. Summary of expert validation results

Validator	Score (%)	Category
Media expert	88	Strongly valid
Material expert	91	Strongly valid
Language expert	84	Valid

Based on Table 1, the average validity of the media falls in the very valid category, indicating that the media has met the criteria of content feasibility, presentation, appearance, language use, and ease of use. The material presented was aligned with the third-grade Indonesian language learning outcomes under the Merdeka Curriculum. The media experts recommended adjusting the background, font size and type, color choice, image size, and layout so that the display would be clearer, more balanced, and easier for students to follow, while the material experts suggested refining the size, font, and color of the text and adding illustrations that better matched the reading content. These suggestions were used as the basis for a first round of product revision before the media was tested with students.

Practicality of the media

The practicality of the media was examined through teacher and student response questionnaires administered after a limited trial (See Figure 6).

**Figure 6.** QuiverVision Activity

Table 2 summarizes the results. The teacher's response indicated that the media was easy to use, had clear instructions, and was well aligned with the learning objectives, with the clarity of instructions for use (92%) and the suitability of the content with the learning objectives (90%) rated as the strongest aspects, while ease of use (70%) and the attractiveness and usefulness of the display (58-60%) were rated somewhat lower and identified as areas for further improvement. Students, for their part, rated the medium as practical (79.88%), reporting that the media was easy to use, had an attractive appearance, and helped them understand the Indonesian language material better. Some students still required guidance in operating the QuiverVision application, since they were not yet accustomed to augmented-reality-based learning media; nevertheless, the overall results indicate that the media met the practicality criteria for classroom use.

Table 2. Summary of practicality results

Respondent	Score (%)	Category
Teacher response	90.00	Very practical
Student response	79.88	Practical
Average	84.94	Very practical

Effectiveness of the media

The effectiveness of the media was examined from students' pretest and posttest scores on the reading-writing literacy test. Descriptive statistics of the test results are presented in Table 3.

Table 3. Descriptive statistics of pretest and posttest scores

Test	N	Minimum	Maximum	Mean (SD)
Pretest	30	26	57	35.87 (6.611)
Posttest	30	75	90	82.67 (3.933)

The Kolmogorov-Smirnov normality test and the Levene homogeneity test showed that both the pretest data (Sig. = .380) and the posttest data (Sig. = .789) were normally distributed and homogeneous (Sig. > .05), so that the data were suitable for further analysis using a paired-sample t-test. The paired-sample t-test produced a mean difference of -46.80, a t-value of -31.746 with 29 degrees of freedom, and a two-tailed significance value of $p < .001$, indicating a statistically significant difference between the pretest and posttest scores. This finding shows that the use of the e-comic media assisted by QuiverVision had a significant effect on the improvement of students' reading and writing literacy.

The effectiveness of the developed E-Comic was evaluated using pretest and posttest scores obtained from classroom implementation. Students completed the pretest before using the media and the posttest after completing all literacy learning activities. The improvement in learning outcomes was analyzed using the Normalized Gain (N-Gain). The results are presented in Table 4.

Table 4. Pretest, posttest, and N-gain results

Group	Number of students	Pretest	Posttest	N-gain	Category
Small group	10	59.50	83.80	0.60	Moderate
Field test	30	60.47	85.70	0.64	Moderate

The results in Table 4 demonstrate a substantial improvement in students' literacy achievement after using the developed E-Comic. During the field trial, the average score increased from 60.47 on the pretest to 85.70 on the posttest. Furthermore, the N-Gain score of 0.64 indicates a moderate improvement, suggesting that the media effectively enhanced students' reading and writing literacy skills.

The magnitude of the improvement was further examined using the N-Gain formula, which produced an average value of 0.64, placing the improvement in the moderate category. This result indicates that, in addition to being statistically significant, the improvement in students' reading and writing literacy after using the QuiverVision-assisted E-Comic was also of meaningful practical significance. To provide a clearer visual comparison, the increase in students' scores is presented in Figure 7.

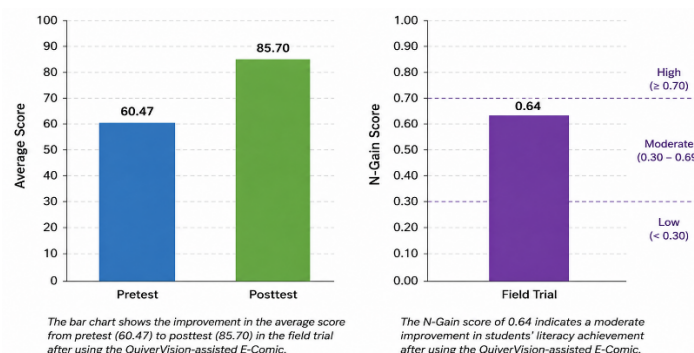


Figure 7. The improvement of small group and field test

The findings indicate that the QuiverVision-assisted E-Comic effectively improved students' reading and writing literacy skills. As shown in Table 7 and Figure 3, the average pretest score increased from 60.47 to 85.70, while the N-Gain score reached 0.64, which is categorized as moderate. These findings demonstrate that the developed media provided a positive contribution to students' learning outcomes.

Discussion

Overall, the results show that the e-comic media assisted by QuiverVision, developed through the ADDIE model, met the three criteria commonly required of an educational product in research and development: validity, practicality, and effectiveness. The needs analysis confirmed that both the teacher and students required a more attractive, interactive, technology-based medium to support reading and writing literacy learning, a finding in line with reports that students respond more actively to interactive visual media than to plain text and that a well-designed multimedia presentation can support comprehension (Mayer, 2021).

The high validity scores obtained from the media, material, and language experts (84-91%) indicate that the developed e-comic met the required standards of content accuracy, visual design, and language appropriateness for third-grade students, consistent with reports that comics combining text and sequential illustration can support young readers' comprehension of a story's characters, setting, and plot (Eisner, 2021; McCloud, 2020) and that digital comics designed for elementary students can be developed to a valid, feasible standard (Khotimah et al., 2021; Mahayani et al., 2024).

The practicality results, an average of 84.94% in the very practical category, suggest that both the teacher and students found the medium usable within an ordinary classroom setting, with particular strength in the clarity of instructions and the alignment of content with learning objectives. This is consistent with the general proposition that augmented-reality features embedded in visual media can make learning more interactive and engaging, thereby facilitating classroom use once initial technical familiarity is established (Azuma, 2021; Kloss, 2022). The comparatively lower ratings for ease of use and attractiveness reported by the teacher, together with some students' need for guidance in operating QuiverVision, point to a practical implication for developers: technical scaffolding and simple in-app instructions are important companions to an AR-based medium, particularly during initial adoption.

The significant increase in students' mean score from 35.87 to 82.67, together with a moderate N-Gain of 0.64, indicates that the e-comic media assisted by QuiverVision was effective in improving reading and writing literacy. This finding supports the view that combining a visual, narrative medium with an interactive technology can help young students identify story elements, comprehend a text's content, and reconstruct that content in their own words in writing, thereby strengthening the connection between reading and writing skills that is considered important at the elementary level (Malpique et al., 2022). The gains reported here are also consistent with earlier findings that digital, comic-based media can support the improvement of elementary students' literacy outcomes when properly validated and trialed (Widianto et al., 2024; Yulaichah, Mariana, & Wirayanto, 2020). However, due to the testing design which did not involve a control group and proper randomization, the testing results may not be generalized and are limited to the observed classroom. In broader educational settings, the results may vary due to external unobserved factors, such as teacher characteristics, classroom environment, students' prior experiences, and other contextual factors that were not examined in this study.

Taken together, these findings suggest that an e-comic media enriched with augmented-reality interactivity offers third-grade teachers of Indonesian language a validated, practical, and effective alternative to conventional print-based literacy instruction, one that supports both reading comprehension and writing production within a single, integrated learning activity. As

this study was conducted at a single school with a relatively small sample and without a comparison class, the findings should be interpreted as evidence of feasibility and promise rather than generalizable impact; broader field trials across schools, together with a control-group design, would strengthen the evidence base for wider adoption.

CONCLUSION

This study set out to describe the need for, design, and evaluate an e-comic media assisted by the QuiverVision application for improving the reading and writing literacy of third-grade elementary school students. The needs analysis showed that both teachers and students required a more attractive, interactive, and technology-based medium to support integrated reading and writing literacy learning. In response to this need, an e-comic media combining a simple narrative, illustrations, and augmented-reality interactivity through QuiverVision was developed using the ADDIE model.

The developed media was declared valid by media, material, and language experts, with scores of 88%, 91%, and 84%, respectively, all in the valid to very valid category. The media was also found to be very practical, with teacher and student responses of 90.00% and 79.88%, respectively, and an average practicality of 84.94%. Finally, the media proved effective in improving students' reading and writing literacy, as shown by an increase in the mean score from 35.87 (pretest) to 82.67 (posttest), a statistically significant paired-sample t-test result, and a moderate N-Gain value of 0.64.

These findings indicate that the e-comic media assisted by QuiverVision meets the criteria of validity, practicality, and effectiveness, and is therefore suitable for use as an alternative Indonesian language learning medium to strengthen integrated reading and writing literacy among third-grade elementary school students. Teachers are encouraged to make creative use of similar technology-based media to make literacy instruction more attractive and interactive, and schools are encouraged to support such use by providing adequate devices, internet access, and training. Future research could extend this media by adding further interactive features, broadening its content coverage, involving more schools and a control-group design, and integrating it with other subjects to widen its use in elementary education.

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DECLARATION

Author contribution

All authors contributed to the research and/or writing the paper, and approved the final manuscript.

<i>Asri Pratiwi</i>	Conceptualizing the research idea, developing the instruments and the media, leading the data collection and field trial, and writing the original draft.
<i>Sulfasyah</i>	Supervising the research design and methodology, reviewing the validity of the data analysis, and revising the manuscript.
<i>Tasrif Akib</i>	Supervising the instrument and media development, reviewing the manuscript, and enriching the discussion of the findings.

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Conflict of interest

All authors declare that they have no competing interests.

Ethics declaration

We as authors acknowledge that this work has been written based on ethical research that conforms with the regulations of our institutions and that we have obtained the permission from the relevant institutes when collecting data. We support the International Journal on Education Insight (IJEI) in maintaining the high standards of personal conduct, practicing honesty in all our professional practices and endeavors.

The use of artificial intelligence

We do not use any generative AI or AI-assisted technology to write any part of this paper.

Additional information

Not available.

REFERENCES

- Alfian, A. N., Putra, M. Y., Rafsanjani, R., & Witjaksono, A. P. (2022). User acceptance test terhadap aplikasi augmented reality Quivervision 3D sebagai media pembelajaran mewarnai. *Informatics For Educators and Professional: Journal of Informatics*, 6(2), 197-206.
- Azuma, R. (2021). A survey of augmented reality. *Presence: Teleoperators and Virtual Environments*, 6(4), 355-385. <https://doi.org/10.1162/pres.1997.6.4.355>
- Borg, W. R., & Gall, M. D. (1983). *Educational research: An introduction*. Longman.
- Branch, R. M. (2009). *Instructional design: The ADDIE approach*. Springer. <https://doi.org/10.1007/978-0-387-09506-6>
- Eisner, W. (1990). *Comics and Sequential Art*. Poorhouse Press.
- Graham, S., & Hebert, M. (2021). *Writing to read: Evidence for how writing can improve reading*. Carnegie Corporation. <https://carnegie.org/publication/writing-to-read-evidence-for-how-writing-can-improve-reading>
- Guthrie, J. T., & Wigfield, A. (2000). Engagement and motivation in reading. In M. L. Kamil, P. B. Mosenthal, P. D. Pearson, & R. Barr (Eds.), *Handbook of reading research* (vol. 3, pp. 403–422). Lawrence Erlbaum Associates Publishers.
- Nadda, N. Q. (2025). Membangun Fondasi pendidikan: solusi atas minimnya kemampuan membaca dan berhitung di sekolah dasar Indonesia. *Publikasi Ilmu Pendidikan Bahasa dan Matematika*, 3(5), 206-215.
- Khotimah, S., Ratnawuri, T., & Pritandhari, M. (2021). Pengembangan e-comic berbasis android sebagai media pembelajaran kelas XI SMA Paramarta 1 Seputih Banyak Lampung Tengah. *Jurnal Ilmiah Pendidikan Ekonomi*, 2(1), 49-58. <https://doi.org/10.24127/edunomia.v2i1.1630>
- Kloss, J. (2022). *Augmented reality in education: Immersive learning and instructional design*. Routledge.
- Mahayani, L. D., Wibawa, I. M. C., & Paramartha, W. E. (2024). Media e-komik berbasis kontekstual untuk meningkatkan keterampilan literasi pada siswa kelas VI sekolah dasar. *International Journal of Natural Science and Engineering*, 8(2), 105–120. <https://doi.org/10.23887/ijnse.v8i2.95771>
- Malpique, A., Limpo, T., & Alves, R. A. (2022). Reading-writing connections in elementary education. *Journal of Educational Psychology*, 114(4), 845-860. <https://doi.org/10.1037/edu0000689>
- Maritim, E. (2023). The essence and curriculum of learning Indonesian language in elementary schools. *International Journal of Education and Literature*, 2(1), 49-57.
- Mayer, R. E. (2021). *Multimedia learning*. Cambridge University Press.
- McCloud, S. (2020). *Understanding comics*. HarperCollins.
- Nurchurifiani, E., & Zulianti, H. (2021). Use of problem-based digital comics in the era of disruption as an increasing effort critical thinking skills and learning achievement. *Journal Corner of Education, Linguistics, and Literature*, 1(1), 1–7. <https://doi.org/10.54012/jcell.v1i1.5>
- Widianto, P. C., Fadhilawati, D., Sutanti, N., & Supriyono, S. (2024). Examining Quizalize's impact on students' reading comprehension mastery English. *Jurnal Pendidikan: Riset dan Konseptual*, 8(2), 338-349.
- Yulaichah, S., Mariana, N., & Wirayanto. (2024). The use of e-comics based on a realistic mathematical approach to improve critical and creative thinking skills of elementary school students. *International Journal of Recent Educational Research*, 5(1), 90-105. <https://doi.org/10.46245/ijorer.v5i1.497>

APPENDIX

The developed QuiverVision-assisted E-Comic can be accessed online through the following link:

<https://online.flippingbook.com/view/625544531/>

<https://www.canva.com/design/DAHIdQN6ZJQ/QKoroV93qGRSCeIY5uxZGA/edit>

This online version allows readers to view the cover page, story pages, literacy activities, and QuiverVision markers used in the study.

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