Citra Journal of Innovative Education Practices

Journal homepage:
https://citralestari.my/index.php/cjiep/index
ISSN: 3093-6942

# The Impacts of Comic-Based Learning on Student Engagement in Primary Education: A Systematic Literature Review

Ruzaini Rafiuddin Rasmet[1], Nur Farha Shaafi[1,*], Sabariah Sharif[1], Suraya Md. Nasir[2], Muhammad Furkan Mat Salleh[3], Ellianawati Ellianawati[4]

[1] Faculty of Education and Sports Studies, Universiti Malaysia Sabah, Kota Kinabalu, Sabah, Malaysia
[2] Faculty of Art, Sustainalibity and Creative Industry, Universiti Pendidikan Sultan Idris, Tanjung Malim, Perak, Malaysia
[3] Faculty of Education, Universiti Teknologi MARA, Puncak Alam, Selangor, Malaysia
[4] Faculty of Mathematics and Natural Sciences, Universitas Negeri Semarang, Semarang, Indonesia

**ARTICLE INFO**

***Article history:***
Received 4 February 2025
Received in revised form 10 March 2025
Accepted 15 April 2025
Available online 1 Jun 2025

***Keywords:***
Comic-based learning; student engagement; primary education; systematic literature review; teaching innovation

**ABSTRACT**

In the 21st century, innovative teaching strategies, which is comic-based learning, have gained prominence for enhancing engagement and conceptual understanding in primary education. A systematic literature review (SLR) has been conducted to examine the design, application, and educational impacts of comic-based learning, focusing on its ability to foster meaningful teaching and learning experiences. The review includes: defining research objectives, conducting a comprehensive search through Web of Science, ProQuest, and ERIC, selecting relevant studies, and synthesizing findings. A total of 20 studies published between 2018 and 2024 were analysed, revealing that comic-based learning is an effective pedagogical tool across various educational contexts, particularly in Science subjects. The findings demonstrate that comics significantly enhance student motivation, engagement, and conceptual understanding while promoting active participation and fostering critical thinking skills. Additionally, the integration of visual and textual elements in comics makes learning more relatable and enjoyable for young learners. The review also highlights the role of comics in differentiated instruction, addressing diverse learning needs and creating inclusive classroom environments. By transforming traditional teaching approaches, comic-based learning contributes to the development of interactive, student-centered learning experiences. This study provides valuable insights for educators, researchers, and policymakers, offering a foundation for future exploration of innovative pedagogical tools.

## 1. Introduction

Education is a key element contributing to the economic development and progress of a nation. It contributes to economic development by boosting productivity, promoting technological advancements, and increasing job opportunities in various sectors, such as agriculture,

* *Corresponding author.*
*E-mail address: farhashaafi@ums.edu.my*

https://doi.org/10.37934/cjiep.1.1.2639

manufacturing, and earnings [1]. The education system of a country plays a crucial role in its rapid growth and development by fostering human capital, which is essential for economic progress. Investing in education positively impacts economic growth by improving workforce skills, productivity, and overall labor efficiency. Countries like Pakistan have shown that a strong education system correlates with higher literacy rates, increased labor force participation, and ultimately contributes to economic expansion [2]. The evolution of education coincides with the advancement of technological tools, leading to increased motivation and emotions in student learning [3]. It is closely aligned with technological advancements in this modern era. One of the core subjects crucial to national development is science. According to the Malaysia Education Blueprint (PPPM) 2013-2025, the Malaysian government continues to emphasize the 60:40 ratio for science subject, a focus in the education system since 1967. Despite the importance of science in Malaysia's education system, the declining number of students opting for science streams is concerning [4]. As a result, the government has taken initiatives to modernize its education system in line with its goal of producing globally competitive students [5,6].

Both national and international education systems emphasize the importance of effective teaching and learning strategies as essential to advancing educational progress. Teachers are central to fulfilling the Ministry of Education's goals by implementing a variety of instructional strategies that actively engage students in the learning process. Key approaches such as problem-based learning (PBL), inquiry-based learning, and project-based learning have gained significant attention for fostering student participation. Using both traditional and modern teaching methods, emphasizing modern methods can lead to more effective teaching and better academic achievements in 21st century science education [7]. Traditional science teaching methods are effective in content delivery but need to be enhanced with innovative techniques to improve student engagement and understanding [8].

However, engaging students' attention, particularly in science, can be challenging. One effective way to enhance student interest is by using visual teaching aids, such as comic books or cartoons. This combination presents real-life scenarios through engaging and visually stimulating narratives. The comic-based learning (CBL) not only contextualizes learning in familiar environments but also nurtures critical thinking and problem-solving skills. Incorporating comics into the curriculum can stimulate curiosity, facilitate retention, and promote critical thinking skills among primary school pupils [9] Comics can also be used to instill positive values and character education, making them a versatile tool in both academic and personal development contexts [10,11].

In the context of science education, the genre of comics, referred to as "science comics," has emerged as a popular tool for communicating scientific concepts to students [12]. Science comics have been shown to significantly improve students' understanding of scientific concepts. Studies indicate that students who engage with science comics demonstrate higher learning gains and more positive attitudes towards science compared to traditional texts [13-15]. The use of science comics in educational settings has been linked to increased student interest and achievement in science subjects. This is particularly evident in students with visual learning preferences, where comics help optimize learning processes through engaging narratives and visuals [16,17]. Consequently, comics have become a widely accepted educational tool, driving positive outcomes in engagement and learning [18].

CBL is an educational approach that utilizes comics as a medium to enhance student engagement and learning outcomes. It differs from conventional methods by incorporating visual storytelling, which can make learning more interactive and enjoyable. Unlike traditional lecture-based methods, CBL offers a more interactive and enjoyable learning experience. It allows students to actively participate in the learning process, which can lead to better learning outcomes [19,20]. CBL leverages

the visual and narrative elements of comics to capture students' interest and make learning more engaging. This approach is particularly effective in subjects like science, computing, and philosophy, where traditional methods may not fully engage students [21,22]. CBL helps students connect academic content with real-life scenarios, making learning more relevant and applicable. This approach can bridge the gap between theoretical knowledge and practical application [23].

Despite the growing use of comics in educational settings, research on their impact on student engagement in primary education remains limited. While studies have explored the effectiveness of CBL in Science and Mathematics, there is a lack of comprehensive analysis of the research methodologies used and the commonalities in content and findings across studies. A systematic literature review is necessary to evaluate how CBL has been studied and applied, addressing methodological trends and thematic consistencies. This study aims to provide valuable insights into the role of CBL in enhancing student motivation, engagement, and critical thinking in primary education.

## 2. Methodology

A systematic literature review attempts to identify, appraise, and synthesize all empirical evidence that meets pre-specified eligibility criteria to answer a given research question [24]. They use explicit methods aimed at minimizing bias to produce more reliable findings [24]. Conducting an SLR involves planning, conducting, organizing, and presenting the review, with a focus on rigorous methodology and quality assessment [25]. Systematic literature reviews are a critical methodology in research, providing a reliable and comprehensive synthesis of existing studies. They are essential for informing practice, policy, and future research directions by offering a structured and unbiased overview of the literature. This literature review explores the impact of CBL on student engagement in primary education. To address this, relevant literature was gathered from multiple online sources, including academic books and journal articles. The research process involved searching through databases such as Scopus, Web of Science (WOS), ProQuest, ERIC, and open-access journals, using keywords like problem-based learning, primary education, student engagement, and comics. Only studies published between 2018 and 2024 were included in the review. A total of 20 studies were identified and analyzed using a four-step systematic review method (see Figure 1), adapted from the approaches described by Breckwoldt *et al*., [26] and Bannuru *et al*., [27].

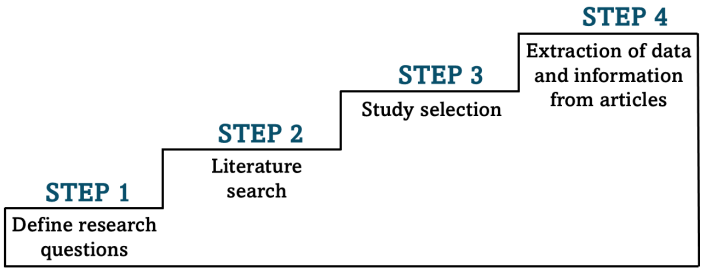


**Fig. 1.** Four steps in analysis of systematic literature review

The first step in this study involved planning and defining clear, precise, and answerable research questions using the PICO framework (Population, Intervention, Comparison, Outcome). In this framework, the Population refers to the primary group targeted in the study, described by characteristics such as age, education level, and nationality. The Intervention involves the use of comic-based learning (CBL) as a teaching method to address educational challenges and improve learning outcomes. The Comparison evaluates CBL in relation to other traditional or non-traditional

teaching approaches, or in the absence of any intervention [27]. Finally, the Outcome focuses on assessing specific improvements, such as students' conceptual understanding, motivation, engagement, and critical thinking skills. The specific PICO elements in this study are as follows: (i) P = students (across primary, secondary, and higher education), all ethnicities, and all nationalities, (ii) I = CBL, (iii) C = other teaching approaches or no intervention, and (iv) O = enhanced conceptual understanding, engagement, motivation, and critical thinking skills.

The second step involved conducting a thorough literature search using databases such as Scopus, Web of Science (WOS), ProQuest, ERIC, and open-access journals. Relevant articles were downloaded and systematically organized in the EndNote application for further review. Boolean logic was employed to refine the search process, combining key terms with connectors such as "AND," "OR," and "NOT" to filter results effectively. For instance, searches such as: (i) "Students" AND "Comic-Based Learning" retrieved articles containing both terms, (ii) "Students" OR "Comic-Based Learning" retrieved articles with either term, and (iii) "Students" NOT "Comic-Based Learning" excluded articles unrelated to comic-based learning. The inclusion of controlled vocabulary, truncation symbols, and strategically placed search terms ensured a robust and targeted literature search.

In the third step, the researcher assessed and selected studies by reviewing the titles and abstracts of identified articles. Only those published between 2018 and 2024 and addressing the study's objectives were included. Key information was extracted from the selected articles and systematically organized into tables. Articles were included if they addressed the research question, while those that did not align with the targeted outcomes or fell outside the specified date range were excluded. Ultimately, 200 articles were chosen for in-depth analysis, following a structured process adapted from Breckwoldt *et al*., [26] and Bannuru *et al*., [27].

Finally, the fourth step involved synthesizing and reporting the findings through literature writing and publishing this systematic literature review. Key information from the selected articles was organized into a synthesis matrix, categorizing details by subthemes, including authors, research objectives, sample or respondents, research design, data analysis, and findings. This systematic organization helped identify similarities and differences across the studies, enabling an in-depth understanding of the impact of CBL. The detailed review and analysis process were adapted from established frameworks by Moher *et al*., [28] and Hayrol Azril *et al*., [29] as illustrated in Figures 1 and 2.

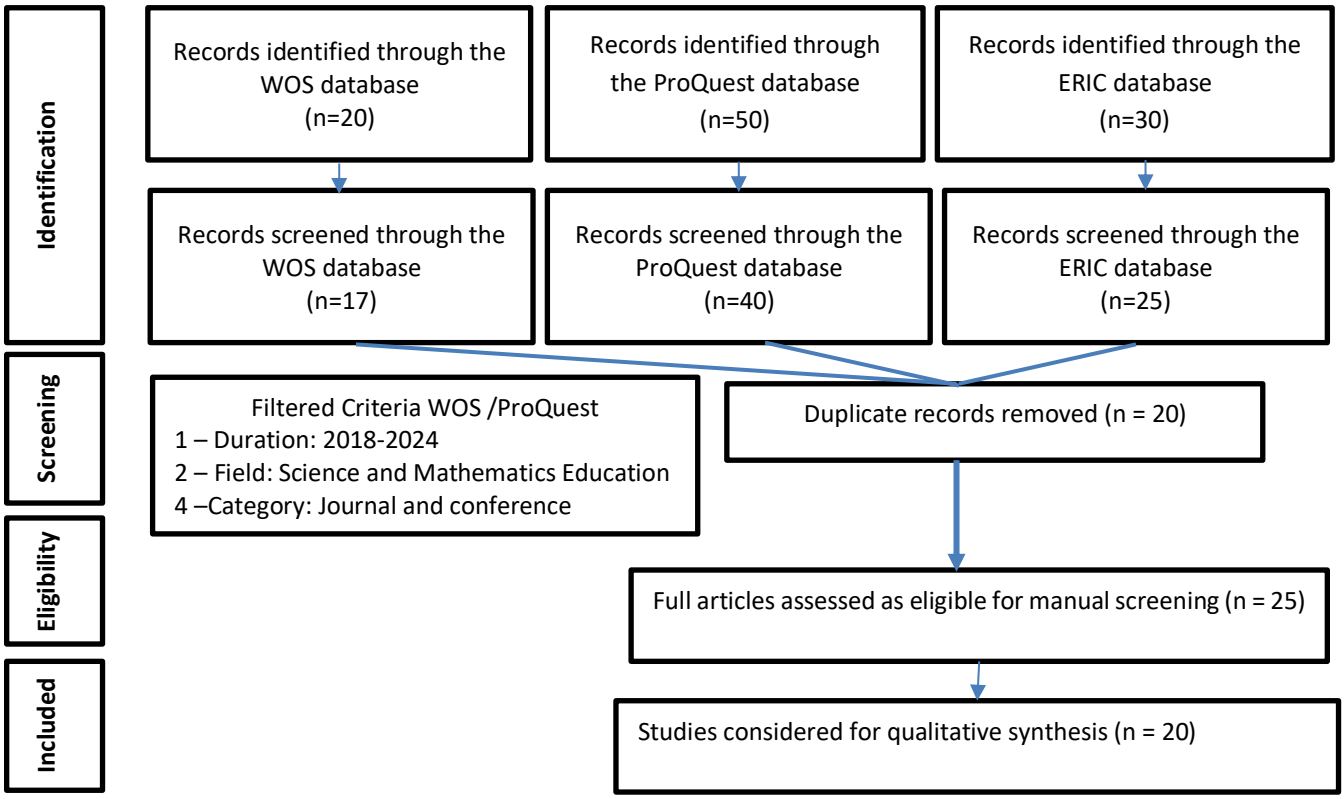


**Fig. 2.** The process of article review

## 3. Results

The twenty studies share certain similarities which are categorized into two key aspects: the methodologies employed, and the similarities in the content.

### *3.1 Analysis of Methodology implemented*

Studies exploring Comic-Based Learning CBL often employ structured research designs, and Research and Development (R&D) models, such as Borg and Gall and ADDIE, are the most prominent among them. These models involve systematic steps like expert validation, iterative revisions, and trials to ensure material effectiveness [30,31]. Additionally, quasi-experimental designs with pre- and post-tests are frequently used to quantitatively measure student outcomes, such as problem-solving skills and academic achievement [31,39]. These designs are critical in evaluating the effectiveness of CBL, as they integrate both quantitative measures, such as statistical tests, and qualitative feedback from educators and students. Furthermore, the key outcomes assessed in these studies include academic achievement, engagement, and higher-order thinking skills, highlighting the multifaceted impact of CBL [30,34]. Therefore, the use of appropriate research designs is essential for obtaining reliable and valid findings, ensuring that the impact on student outcomes is thoroughly analyzed [35].

Moreover, mixed-method approaches, which combine quantitative and qualitative methods, are highly effective in establishing the relationship between CBL and student engagement. For instance, quantitative techniques, such as t-tests and descriptive statistics, are used to measure improvements in academic performance and cognitive understanding, whereas qualitative methods, such as interviews and thematic analysis, provide deeper insights into students' experiences [30,39]. These

methods also reveal the influence of CBL on critical thinking and problem-solving skills. For example, studies indicate that students demonstrate enhanced comprehension and critical thinking when engaging with well-designed educational comics [31]. In addition, the development and refinement of educational tools through these methods ensure that the comics remain engaging and effective, addressing specific aspects of student learning, such as motivation and cultural relevance [32,35].

The iterative nature of R&D processes, such as Borg and Gall and ADDIE, also contributes significantly to improving teaching strategies using CBL. These methods emphasize systematic evaluation and continuous feedback from experts, educators, and students, thereby ensuring the development of high-quality materials [31,34]. The refinement of educational comics is particularly important for maintaining student engagement and fostering skill development. Additionally, structured frameworks, such as ADDIE, provide a comprehensive approach to creating and evaluating CBL tools, ensuring alignment with educational goals and student needs [30]. Consequently, systematic approaches, incorporating both formative and summative evaluations, play a crucial role in the successful implementation of these tools in diverse educational settings [35,39].

Quantitative methods are extensively used to analyze the effectiveness of CBL, as statistical techniques such as meta-regression and variance estimation provide valuable insights into learning outcomes [34]. These approaches are particularly effective in evaluating the impact of comics on academic performance, engagement, and interest. However, qualitative methods, such as thematic analysis and classroom observations, complement quantitative findings by offering a richer understanding of students' experiences and perceptions [32,39]. Together, these methods provide a comprehensive evaluation by capturing both measurable outcomes and nuanced student interactions, which are crucial for assessing the effectiveness of CBL [30,35].

Finally, the distribution of research samples across primary, secondary, and higher education reveals important insights into the applicability of CBL. For instance, studies often focus on primary education, as younger students respond positively to visually engaging and interactive learning tools [31,35]. However, research in secondary and higher education adds value by exploring the broader applicability of comics, particularly in fostering critical thinking and subject-specific engagement [32, 39]. Thus, this distribution underscores the potential of CBL to benefit students at various educational levels, highlighting its versatility and effectiveness across diverse contexts [34,35].

In conclusion, CBL is a highly effective and adaptable educational tool that enhances academic performance, engagement, and critical thinking. Supported by structured designs like Borg and Gall and ADDIE, along with mixed-method approaches, it combines quantitative insights and qualitative depth to optimize learning outcomes. Its versatility across educational levels highlights its potential to meet diverse learning needs, making education both enjoyable and impactful. Future research should explore broader applications and innovations to sustain its relevance in modern education.

### *3.2 Analysis of similarities in the content*

Comic-based learning (CBL) has gained popularity as an effective educational tool, particularly in primary education, where engaging and interactive materials are essential. Common themes in CBL materials often include moral values, environmental awareness, and daily life scenarios, which are carefully designed to align with the needs of integrative thematic learning. These themes not only support the development of critical thinking and problem-solving skills but also help integrate concepts from various subjects such as science, social studies, and civic education [30,31]. For instance, topics like the water cycle or socio-cultural diversity are consistently addressed, ensuring that students gain a holistic understanding across multiple disciplines. Furthermore, maintaining

consistency in content themes is critical as it allows for the standardization of educational materials across different studies, ensuring that learning objectives are universally met [35].

Additionally, educational comics employ storytelling techniques such as relatable characters, simple language, and engaging plots to effectively capture students' attention. These techniques not only make the content more accessible but also allow students to connect emotionally with the material, enhancing their overall engagement [39]. For example, narratives that mirror real-life experiences simplify abstract concepts and improve comprehension. Moreover, characters that face challenges and solve problems encourage students to think critically and understand subject matter more deeply [34]. As a result, storytelling approaches in educational comics foster engagement while simultaneously enhancing knowledge retention.

Similarly, recurring visual elements such as vibrant colors, expressive characters, and well-structured layouts significantly contribute to achieving learning objectives. These elements are particularly effective in making abstract concepts tangible and maintaining student interest throughout the learning process [31]. Furthermore, consistency in visual design—such as clear panel layouts and balanced text-to-image ratios—ensures that students can easily navigate the material, leading to a more effective and enjoyable learning experience [30].

In terms of instructional strategies, integrating comics into classroom learning often involves collaborative group work, role-playing, and guided discussions. These shared strategies actively engage students and align comic-based materials with curriculum goals and standards [39]. For instance, group assignments based on comic themes encourage teamwork and critical analysis, helping students apply what they learn to real-world scenarios. As a result, these strategies not only enhance engagement but also ensure the educational relevance of CBL [35].

Furthermore, the structured layout of CBL materials, including sequential paneling and thematic organization, plays a crucial role in ensuring accessibility for students. These structural similarities maintain clarity and ease of understanding, enabling students to focus on learning objectives without unnecessary distractions [30]. Additionally, uniformity in design and presentation allows students from diverse educational settings to equally benefit from the material, making comic-based resources highly versatile [31].

Moreover, shared themes in educational comics, such as environmental challenges and scientific phenomena, encourage students to think critically and solve problems creatively. For example, themes like recycling or climate change link classroom learning to real-world contexts, making education more meaningful and relatable [35]. Relatable scenarios presented in comics further enhance students' ability to apply learned concepts in their everyday lives, fostering deeper understanding and skill development [39].

The tone and language of educational comics are also key factors in their success. Typically light, engaging, and tailored to primary school students, these elements help create a positive emotional connection with readers. By incorporating humor and relatable characters, comics make learning enjoyable and memorable [31]. Additionally, the consistent use of simple vocabulary ensures that materials are accessible to young learners, enhancing both engagement and comprehension [30].

Finally, recurring pedagogical techniques, such as scaffolded learning and thematic consistency, ensure continuity in teaching methodologies across various educational settings. These elements not only make CBL universally adaptable but also allow educators to tailor content to specific classroom needs while maintaining its effectiveness [35]. Moreover, thematic consistency in comics contributes to a cohesive learning experience, enabling students to connect various concepts seamlessly [39]. Together, these factors demonstrate the versatility and effectiveness of CBL as a valuable tool in modern education. The details of twenty studies that employed different methodologies and shown the similarities in the content and findings are shown in Table 1.

**Table 1**
Analysis of studies from 2018 to 2024

| No | Researchers | Sample | Purpose of the Study | Research Design | Findings |
|---|---|---|---|---|---|
| 1 | Rani Febriyanti and Ali Mustadi [31], Indonesia | 72 fifth-grade students from two schools in Yogyakarta, Indonesia | To create edutainment-based comics for fifth-grade integrative-thematic learning using the Borg & Gall R&D model. | Research & Development with steps including product design, small and large-scale trials, and revisions | Validation results showed very high feasibility scores:<br>Media experts: 92.27%<br>Content experts: 91.63%<br>Teachers: 91.6%<br>Student response in small class trials: 84.72%<br>Student response in large class trials: 91.6% |
| 2 | Sri Wulan Anggraeni, Yayan Alpian, Depi Prihamdani, Tia Damayanti [30] Indonesia) | 64 fourth-grade students from primary school Negeri Margasari II, divided into experimental (32) and control (32) groups | To create and evaluate the feasibility of comic-based teaching materials for fourth-grade elementary students using the R&D method based on Sugiyono's model. | Research and Development (R&D) with stages: literature review, product design, expert validation, small-scale trial, large-scale trial, and final product revision | Material expert score: 91%<br>Language expert score: 93%<br>Media expert score: 94%<br>Experimental class average score: 85.47 (higher than control class average of 80.63) |
| 3 | Mazlini Adnan *et al*., [45] Malaysia | 307 Year One students from 11 primary schools in Hulu Langat district, Selangor, Malaysia. Sample selection was based on a randomized stratified method | To develop and evaluate the effectiveness of STEM comics in teaching Year One science and mathematics, aiming to enhance students' understanding, interest, and higher-order thinking skills (HOTS). | Single-Group Post-Test Only Quasi-Experiment method using the TPACK model to align technology, pedagogy, and content. The study included the creation of 10 STEM comic series with themes like "Playground," "Sports," and "The Rain Oh Rain" | High mean values for interest in comics (2.63), science (2.65), and mathematics (2.63). |
| 4 | Idayanti, Marlina, Utaminingsih, Sri, and Surachmi, Sri [33] Indonesia) | 76 fourth-grade students from three schools in Purwodadi District:<br><br>Experimental Class A (24 students), Experimental Class B (27 students), and Control Class (25 students) | To develop and evaluate the effectiveness of digital comics as a learning medium to improve understanding of natural resources and environmental awareness among fourth-grade elementary students. | Research & Development using Borg and Gall's model, with pre-test and post-test analysis in a quasi-experimental setup | Validation scores: Linguists (3.07), Material experts (2.94), Media experts (3.17), all categorized as "Eligible."<br>Significant improvement in pre-test and post-test scores:<br>Experimental Class A: +34.66<br>Experimental Class B: +30.16 |
| 5 | Tom Jungbluth, Martin Schwichow, Silke Mikelskis-Seifert, and Josef Künsting [34] Germany | 23 quantitative studies (2013–2023) on comics in science education | To analyze the effectiveness of comics in science education for cognitive and affective learning, focusing on instructional design | Meta-analysis using robust variance estimation, assessing effect sizes and moderating factors like panel layout and coherence. | Average effect size: 0.52 (moderate impact).<br>Cognitive outcomes (0.75) were higher than affective outcomes (0.43). |

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| | | | features. | | |
| 6 | Ain Najwa Md Rafit, Suriani Abu Bakar, Anis Nazihah Mat Daud, Muqoyyanah, & Rosmanisah Mohamat [35] Malaysia and Indonesia | 20 studies (2015–2023) on comic-based learning across primary, secondary, and higher education | To evaluate the effectiveness of comic-based learning in science subjects (Physics, Chemistry, Biology, and Mathematics) and its impact on understanding, motivation, engagement, and critical thinking. | Systematic literature review with steps: research planning, database search (Scopus, ProQuest, ERIC), study selection, and analysis | Comics improve concept understanding, motivation, and classroom engagement.<br>Significant gains in science subjects, with positive perceptions from teachers and students |
| 7 | Ahmad Sidqi Danial and Hafizhah Zulkifli [36] Malaysia | argeted at Year 4 students learning Islamic fasting concepts | To develop educational comics using Pixton software for teaching Islamic fasting concepts, focusing on enhancing understanding and engagement through constructivist learning theory. | Concept paper outlining educational comic development using digital tools like Pixton, based on constructivist principles to integrate visuals and narratives for effective teaching | Comics enhance students' understanding of fasting by simplifying complex topics with engaging visuals.<br>Pixton's features (dialogue boxes, dynamic avatars, and visual elements) support interactive learning. |
| 8 | Ida Mauludyah & Septinaningrum [37] Indonesia) | Literature-based analysis of studies on comic media in science education. | To assess the effectiveness of comics in making science learning engaging and accessible for elementary students. | Qualitative literature review analyzing benefits and impacts of comic media in teaching science. | Comics visually stimulate and boost learning motivation. They simplify science concepts with engaging visuals and narratives. It's outperformed textbooks by offering colourful and relatable content. |
| 9 | Ika Maryani and Luluk Amalia [38] Indonesia | Small group trial: 5 students.<br>Large group trial: 20 students from Muhammadiyah Ngijon 1 Elementary School. | To develop a science comic book for 5th-grade students and assess its feasibility and effectiveness in improving their understanding of science concepts, using the ADDIE model. | Research and Development (R&D) using the ADDIE model (Analysis, Design, Development, Implementation, Evaluation. | Media expert score: 93.75% (high feasibility).<br>Material expert score: 85% (high feasibility).<br>Learning expert score: 93.1% (high feasibility).<br>Small group trial score: 100% (students), 95% (teacher).<br>Large group trial score: 94.1% (students), 95% (teacher).<br>Pre-test and post-test results showed significant improvement in students' understanding. |
| 10 | Hong-Yii Phoon, Roslinawati Mohd Roslan, Masitah Shahrill, and Hardimah Mohd. Said [39] Brunei Darussalam) | 18 Grade 5 students (9–11 years old) from a government elementary school in Brunei. | To explore the role of comics in teaching the science topic "Plant Systems" to Grade 5 students, assessing its impact on understanding, engagement, and enjoyment through an action research approach. | Action research with four stages: Planning, Implementation, Observation, and Reflection. A 15-page colored comic featuring the character "Nym" was used as the primary teaching tool. | Post-test scores (mean: 35.39) significantly improved over pre-test scores (mean: 11.88).<br>Students showed high engagement, enjoyment, and interest during lessons.<br>Themes from interviews included enjoyment, engagement, and positive views on using comics in the |

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| | | | | | classroom. |
| 11 | Alisa Asli, Roslinawati Roslan, Masitah Shahrill, and Kabara Auwal Halabi [15] Brunei Darussalam) | 50 samples of Year 3 students from a government primary school in Brunei Muara District | To assess the effectiveness of Islamic-integrated science comics in improving understanding and performance on "Reuse and Recycle." | Mixed-method action research with three cycles (Look, Think, Act) using pre- and post-tests. | Post-test scores improved significantly (Cycle 1: +4.14, Cycle 3: +4.15).<br>Students showed better understanding, motivation, and enjoyment.<br>Strong connections were made between science concepts and Islamic values. |
| 12 | Nurul Hermiyati, Herlina Usman, Nurafiah Rizkiyani, and Lilik Fitriani [40] Indonesia | Fifth-grade students from two schools: SDN Cikahuripan 01 and SD Bojong Nangka 02, Bogor, Indonesia. | To develop and evaluate the feasibility of a comic-based learning media using the TANDUR learning model (Grow, Experience, Name, Demonstrate, Repeat, Celebrate) for fifth-grade elementary students. | Research and Development (R&D) using the 4D model (Define, Design, Develop, Disseminate) to create and test the comic page creator learning media. | Media expert validation: 96.36% (very feasible).<br>Material expert validation: 95% (very feasible).<br>Linguist validation: 94.54% (very feasible).<br>Student response scores:<br>SDN Cikahuripan 01: 86.75%.<br>SDN Bojong Nangka 02: 87.23%. |
| 13 | Muhammad Haris, Akmaluddin, and Mulia Putra [41] Indonesia | 30 fifth-grade students from Paya Kalui State Elementary School (15 boys, 15 girls). | To develop and evaluate the feasibility of comic-based integrated science teaching materials using the ADDIE model to enhance student understanding and engagement. | Research and Development (R&D) using the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) with expert validation and classroom implementation. | Validation scores: Media (96%), Material (96%), Language (98%).<br>Student response: 90% approval.<br>Teacher response: 94% approval.<br>Pre-test average: 70; Post-test average: 91.<br>N-Gain score: 0.91 (high effectiveness) |
| 14 | Yanti Fitria, Adam Malik, Mutiaramses, Siti Hajar Halili, and Rizky Amelia [42] Indonesia and Malaysia | 38 third-grade students from a private elementary school in Padang City, Indonesia (19 in experimental and 19 in control groups) | To develop digital comics on the topic of organism characteristics for elementary school science, aimed at enhancing students' scientific literacy through problem-based learning (PBL). | Quasi-experimental study with a non-equivalent group pre-/post-test design. The digital comics were developed using Comic Life 3 software. | Experimental group's post-test average score: 89.6 (control: 82.2).<br>Significant improvement in scientific literacy ($p < 0.05$).<br>92% of students found comics engaging and helpful for understanding the material. |
| 15 | Septya Khusnia Putri, A.F. Suryaning Ati MZ, and Oriza Zativalen [43] Indonesia | 47 fifth-grade students from MIN 1 Lamongan, divided into experimental and control groups. | To assess the effectiveness of e-comics as a learning tool for improving fifth-grade students' understanding of science concepts in elementary schools. | Quantitative research using a pretest-posttest control group design. The experimental group used e-comics, while the control group used conventional learning methods. | Validation scores: Average 4.1 (very feasible).<br>N-Gain scores: Experimental group (74.47%, high category), Control group (51.44%, moderate category).<br>T-test results showed significant differences in understanding between the two groups ($p < 0.05$). |

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| 16 | Arif Rohman Mansur, Ira Mulya Sari, Yelly Herien, Meri Neherta, and Mei Chan Chong [44], Indonesia and Malaysia | 66 elementary school students (aged 9–12) from public and private schools in Padang City, divided into intervention (33 students) and control groups (33 students). | To evaluate the effectiveness of comic media in improving elementary school students' knowledge about COVID-19. | Quasi-experimental design with pretest and posttest for control and intervention groups | Significant improvement in posttest scores for the intervention group (M = 4.33) compared to the control group (M = 1.63, p = 0.001). |
| 17 | Norazilawati Abdullah, Mazlini Adnan, Laili Farhana Ibharim, Tan Wee Hoe, Dahlia Janan, Jafri Malin Abdullah, Noorzeliana Idris, and Amila Saliza Abdul Wahab [45] Malaysia | 13 excellent science and mathematics teachers from Hulu Langat District involved in content development, with illustrations created by university lecturers. | To develop STEM comics for Year One science and mathematics subjects, based on the Technological Pedagogical Content Knowledge (TPACK) model, aimed at enhancing students' interest and achievement. | Two-phase development process:<br><br>STEM comic content development based on syllabus analysis and storyline mapping.<br>Expert review and revisions for quality and suitability. | Comics contain 10 series integrating science and mathematics topics.<br>Validated as feasible and suitable by expert panels for Year One students.<br>Themes such as "Playground," "Rain," and "Picnic at Port Dickson" used to teach core concepts. |
| 18 | Ida Mauludyah & Septinaningrum [46] Indonesia | Literature-based study analyzing various related research articles on the topic. | To examine the use of comic media in teaching science to elementary school students and its impact on learning effectiveness and motivation. | Descriptive qualitative research focusing on literature review, collecting data from books, journals, and related studies. | Comics enhance learning effectiveness and motivate students through engaging visuals.<br>Key benefits include stimulating visual learning, improving learning outcomes, increasing motivation, and simplifying complex science topics. |
| 19 | Neni Hermita, Henni Setia Ningsih, Jesi Alexander Alim, Mahmud Alpusari, Zetra Hainul Putra, Subuh Anggoro, and Tommy Tanu Wijaya [47] Indonesia | Teachers and fourth-grade students from selected schools. | To develop and evaluate the feasibility of science comics for teaching fourth-grade students about animal diversity, using the ADDIE model. | Research and Development (R&D) based on the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). | Media validation scores:<br>Display aspect: 3.3 (valid).<br>Content aspect: 3.8 (very valid).<br>Teacher response: 95.9% (very feasible).<br>Student response: 94.8% (very feasible). |
| 20 | Farah Nadia Azman, Syamsul Bahrin Zaibon, and Norshuhada Shiratuddin [48] Malaysia | Five comic types: graphic novels, compilations, magazines, comic-based novels, and textbooks | To analyze how educational comics can counter negative stigma and integrate academic and moral values. | Qualitative analysis of comics' educational elements, focusing on academic content and character-building values. | Two content types: academic knowledge (e.g., science, history) and moral values (e.g., health, spirituality).<br>Key elements: simple language, engaging visuals, culturally relevant theme. |

## 4. Conclusions

Comic-based learning (CBL) is a powerful, adaptable tool that enhances learning by fostering engagement, creativity, and critical thinking. Its integration into curricula creates enjoyable, interactive environments that simplify complex concepts. Educators should embrace CBL to maximize

its benefits. This study has several limitations, including a restricted literature scope (2018–2024), potential regional bias, and a primary focus on science and mathematics, limiting its generalizability across subjects and contexts. The lack of longitudinal data constrains insights into long-term effects, while methodological inconsistencies and limited exploration of teacher perspectives hinder a comprehensive evaluation. Additionally, potential publication bias may favor studies reporting positive outcomes.

**Acknowledgement**
This article is supported by a Fundamental Research Grant Scheme-Early Career (FRGS-EC) with research code: FRGS/1/2024/SSI09/UMS/02/6 and *Geran Dana Kluster* with the research code: DKP0105. The author would like to express gratitude to Universiti Malaysia Sabah (UMS) and Ministry of Higher Education (MOHE) Malaysia for supporting this research financially.

**Acknowledgement**
This research was not funded by any grant.

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