Jurnal Riset Pendidikan dan Inovasi Pembelajaran Matematika
JRPIPM. 2026 (Vol. 10, no. 2, 172-187)
ISSN: 2581-0480 (electronic)
URL: journal.unesa.ac.id/index.php/jrpipm

A Systematic Literature Review of The Use of Pop-Up Books in Mathematics Education: Trends, Methods, and Learning Outcomes

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Submitted: 6 March 2026; Revised: 17 June 2026; Accepted: 6 August 2026

ABSTRACT

Mathematics learning requires instructional media that can help students understand abstract concept in a more meaningful and engaging way. One medium that has attracted increasing attention is pop-up book. Although numerous studies have investigated the use of pop-up books in mathematics education, the finding remain scattered across different educational levels, mathematical topics, and research approaches. Therefore, a comprehensive synthesis is needed to prove a clearer understanding of research trends and finding in this area. This study aims to analyze the implementation of pop-up book in mathematics learning through a Systematic Literature Review (SLR) approach. The review was conducted using the PRISMA framework. Data were collected from Scopus, Semantic Scholar, and Google Scholar, with publication period between 2016 and 2025. After the screening process, 23 articles met the established criteria. The findings indicate that pop-up book are most frequently applied in geometry topics, especially at the elementary and junior high school levels. Research and Development (R & D) was the most commonly used approach with pop-up book primarily serving as instructional media. Overall, the reviewed studies reported positive effects on students' learning motivation, conceptual understanding, and problem-solving skills, mathematics communication, and learning achievement. In conclusion, pop-up book have considerable potential to support mathematics learning across various topics and educational levels. However, existing studies mainly focus on teacher developed media, while students 'involvement in designing and creating pop-up book remain largely unexplored. Future research should investigate student-centered approaches that integrate pop-up book creation into mathematics learning.

Keywords: *Pop-up book; mathematics education; learning media; teaching aids*

Tinjauan Literatur Sistematis Penggunaan *Pop-Up Book* dalam Pembelajaran Matematika: Tren Penelitian, Metode, dan Hasil Pembelajaran

ABSTRAK

Pembelajaran matematika membutuhkan media pembelajaran yang dapat membantu siswa memahami konsep abstrak dengan cara yang lebih bermakna dan menarik. Salah satu media yang menarik adalah

pop-up book. Meskipun banyak penelitian yang telah meneliti penggunaan *pop-up book* dalam pembelajaran matematika, namun temuan – temuannya masih tersebar di berbagai tingkat pendidikan, topik matematika, dan pendekatan penelitian. Oleh karena itu, diperlukan suatu kajian komprehensif untuk membuktikan pemahaman yang lebih jelas tentang tren dan temuan di bidang ini. Studi ini bertujuan untuk menganalisis implementasi *pop-up* book dalam pembelajaran matematika melalui pendekatan *Systematic Literature Review* (SLR). Tinjauan dilakukan menggunakan kerangka PRISMA. Data dikumpulkan dari Scopus, Semantic Scholar, dan Google Scholar, dengan rentang waktu publikasi antara tahun 2016 hingga 2025. Dari proses seleksi diperoleh 23 artikel yang sesuai dengan kriteria yang telah ditetapkan. Temuan menunjukkan bahwa *pop-up book* lebih banyak diterapkan pada materi geometri, terutama pada tingkat sekolah dasar dan sekolah menengah pertama. *Research and Development* (R & D) adalah pndekatan penelitian yang paling banyak digunakan dengan *pop-up book* berfungsi sebagai media pembelajaran. Secara keseluruhan, dari hasil studi yang ditinjau menunjukkan efek positif *pop-up book* pada motivasi belajar siswa, pemahaman konseptual, dan keterampilan pemecahan masalah, komunikasi matematika, dan prestasi belajar. Kesimpulannya, *pop-up book* memiliki potensi yang cukup besar untuk mendukung pembelajaran matematika di berbagai topik dan tingkat pendidikan. Namun, studi yang ada sebagian besar hanya berfokus pada media yang dikembangkan oleh guru, sementara keterlibatan siswa dalam mendesain dan membuat *pop-up book* masih belum banyak dieksplorasi. Penelitian selanjutnya dapat dilakukan untuk menyelidiki pendekatan pembelajaran yang berpusat pada siswa yang mengintegrasikan pembuatan *pop-up book* dalam pembelajaran matematika.

Kata Kunci: *Pop-up book, media pembelajaran, alat peraga, pembelajaran matematika*

How to cite: Handayani, A.W.T., Mardiyana, Fitriana, L., & Nurhasanah, F. (2026). A Systematic Literature Review of The Use of Pop-Up Books in Mathematics Education: Trends, Methods, and Learning Outcomes. *Jurnal Riset Pendidikan dan Inovasi Pembelajaran Matematika (JRPIPM)*, *10*(2), 172-187. https://doi.org/10.26740/jrpipm.v10n2.p172-187

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1. Introduction

Mathematics learning occupies a crucial position in the education system, especially in formal education. Mathematics not only serves as a tool for other disciplines but also contributes to develop logical, systematic, and critical thinking skills. According to the National Council of Teachers of Mathematics (NCTM), the primary goals of learning mathematics include problem-solving, reasoning, connections, communication, and representation (Reston, 2000). Similarly with that statement, Fajri et al. (2019) also states that mathematics not only focuses on developing computational skills but also plays a role in improving soft skills. These skills include the ability to discover concepts, process information, and communicate ideas through symbols, graphics, images, verbal forms and writing. Although mathematics has been taught from the elementary level, in practice it is often perceived as abstract and difficult to understand. For many students, mathematics is considered as a challenging subject (Mulianti, 2017). This condition creates the need to create meaningful and enjoyable mathematics learning while also fostering students' creativity. This way, students will not only understand mathematical concepts but also enable to apply mathematics in solving everyday problems. However, in reality, mathematics instruction is still often delivered monotonously through

traditional lectures. Such practice may lead to student's boredom and also decrease their learning motivation.

Nengsi et al. (2020) state that learning is an effort by teachers to provide knowledge to students, in which students gain their learning experiences that influence their behavior. Therefore, teachers must consistently strive to ensure that mathematics learning is not monotonous but rather engaging and motivating. One effective way to approach that is by integrating appropriate learning media or instructional aids, which can enhance students' curiosity and engagement. According to this statement, Ompusunggu (2022) highlight that learning media supports teachers in delivering mathematics instruction, a subject that is often disliked by students.

The use of learning media can assist teachers create more engaging process in the classroom. Learning media plays a crucial role in stimulating students' interest, reducing boredom, and supporting the achievement of active and productive learning outcomes (Yuwono et al., 2021). In mathematics education, the use of appropriate learning media becomes important because many mathematical concepts are abstract and difficult for students to understand when delivered solely through verbal explanation without the support of learning media. One type of learning media that can supports the visualization of mathematical concepts is the pop-up book. A pop-up book is a learning media which design in the form of a book that contains folded elements that create three-dimensional effects when opened. According to Dewanti et al. (2018), the use of pop-up books in learning offers several benefits including fostering children's interest in books and reading, encouraging critical thinking and creativity, and helping learners gain meaning through attractive visual representations that stimulate curiosity and reading motivation.

The potential effectiveness of pop-up books in mathematics learning can also be explained through constructivist learning theory and multimodal learning theory. Constructivism emphasizes that learners actively construct knowledge through meaningful interactions with learning materials and experiences. Meanwhile, multimodal learning theory suggests that the integration of visual, textual, and spatial representations can facilitate a deeper understanding of abstract concepts. The interactive and three-dimensional characteristics of pop-up books provide opportunities for students to engage with mathematical ideas through multiple modes of representation, thereby supporting conceptual understanding and learning engagement. Despite these advantages, pop-up books have mostly been applied in children's storybooks or literacy learning (Azzahroh, *et.al*, 2024), while their application in mathematics learning remains relatively limited. This particularly is noteworthy considering that the visual, engaging, and interactive characteristics of pop-up books have significant potential to increase students' engagement and help them understand abstract mathematical concepts more effectively.

In recent years, several studies have examined the development and more effective implementation of pop-up books in mathematics learning (Baskara, *et.al*, 2023). However, research on the use of pop-up books in mathematics education remains fragmented across various studies with different focuses and research methods. As a result, this situation indicates a lack of comprehensive and systematic studies that map research developments and trends, identify implementation patterns, and evaluate the effectiveness of pop-up books in mathematics learning. This gap highlights the need for a systematic review of prior studies to better capture how pop-up books have been applied in mathematics learning and to evaluate the evidence related to their impact on student's learning experience. Without a systematic synthesis, it will be challenging for researchers and educators to trace research patterns, methodological tendencies, and potential directions for further innovation in pop-up book-based learning media.

To address this gap, the present study adopts a systematic review approach guided by the PRISMA framework. The review is designed to examine prior research on the application of pop-up books within mathematics instruction in a structured and transparent manner. Throughout this process, the study seeks to map recent research developments and identify key patterns across existing studies. In addition, this study also aims to contribute to the field of mathematics education by synthesizing research on the use of pop-up books in mathematics learning. To achieve these objectives, the following research questions are formulated:

1. In which mathematics topics have pop-up books been implemented in mathematics learning?
2. At which educational levels are pop-up books used in mathematics education?
3. What research methods have been employed in studies on pop-up books in mathematics education?
4. What purposes underlie the use of pop-up books in mathematics learning?
5. What findings have been reported regarding the effectiveness of pop-up books in mathematics learning?

2. Method

This study applies a *Systematic Literature Review* (SLR) to examine previous research related to the topic under investigation. SLR is a research methodology developed to collect and critically evaluate studies related to a specific topic of interest (Lusiana & Suryani, 2014). In similar, Norlita et al. (2023) defined SLR as a systematic technique to gather, critically examine, integrate, and synthesize research findings in order to address specific research questions.

The review process was carried out using the PRISMA framework as a guide to ensure a structured and transparent workflow. The procedure involved several interconnected steps, including determining study eligibility, locating relevant sources, organizing the search process, selecting appropriate studies, and compiling as well as analyzing the required data. The study selection process followed four main stages of the PRISMA framework, namely identification, screening, eligibility, and inclusion. This review did not include a formal quality appraisal or risk-of-bias assessment. The study primarily aimed to map research trends, characteristics, and findings related to the use of pop-up books in mathematics learning. Therefore, the inclusion process focused on predefined inclusion and exclusion criteria, publication relevance, and alignment with research objectives. Future reviews may incorporate formal appraisal tools such as CASP or MMAT to provide a more comprehensive evaluation of study quality.

Relevant studies were retrieved from several academic database, including Scopus, Semantic Scholar, and Google Scholar. The literature search employed combinations of keywords related to pop-up book and mathematics learning, including “pop-up book”, “mathematics learning”, “mathematics education”, and “learning media”. Boolean operators such as AND and OR were used to refine the search process. To maintain the focus of the review, the collected studies were carefully selected based on specific criteria. Only publications from the last ten years (2016 – 2025) were considered to ensure the novelty of data. A detailed description of the criteria is provided in Table 1.

Table 1. Inclusion and Exclusion Criteria

No	Inclusion Criteria	Exclusion Criteria
1.	Publications released within 2016 and 2025	Publications before 2016
2.	Articles that directly address the focus of this review	Articles that does not fit the scope of the research
3.	Articles published in scholarly peer-reviewed journal	Non journal sources such as theses, dissertations, reports, or books
4.	Empirical studies using various research approaches	Studies that apply systematic review
5.	Articles with accessible full text content	Articles with restricted acces or unavailable full text

During the data collection stage, each selected article was carefully reviewed, and key information from each study was recorded. Rather than focusing on a single aspect, various component were considered to obtain a more comprehensive picture of the studies being analyzed. These components included general publication information, such as author, title, source, and year of publication, as well as methodological aspects, including research design, objectives, data collection techniques, and instruments were used. Furthermore, the study considered the research context, such as educational level, research location, sample characteristics, and the mathematics topics discussed. Specific attention was also paid to how pop-up books were developed and implemented, including their types and characteristics, the accessibility of the articles, and the key findings reported in each study.

An initial search in Scopus, Semantic Scholar, and Google Scholar yielded 97 records. After identifying and removing duplicate entries, the dataset was reduced to 74 studies. Initial screening based on title and abstracts resulted in the exclusion of 45 articles, leaving 29 studies for more detailed examination. These remaining articles were then fully reviewed to determine their relevance to the research, resulting six articles that did not meet the established criteria. In the final stage, a total of 23 studies were retained and analyzed. The overall process of study identification and selection is illustrated in the PRISMA flowchart shown in Figure 1.

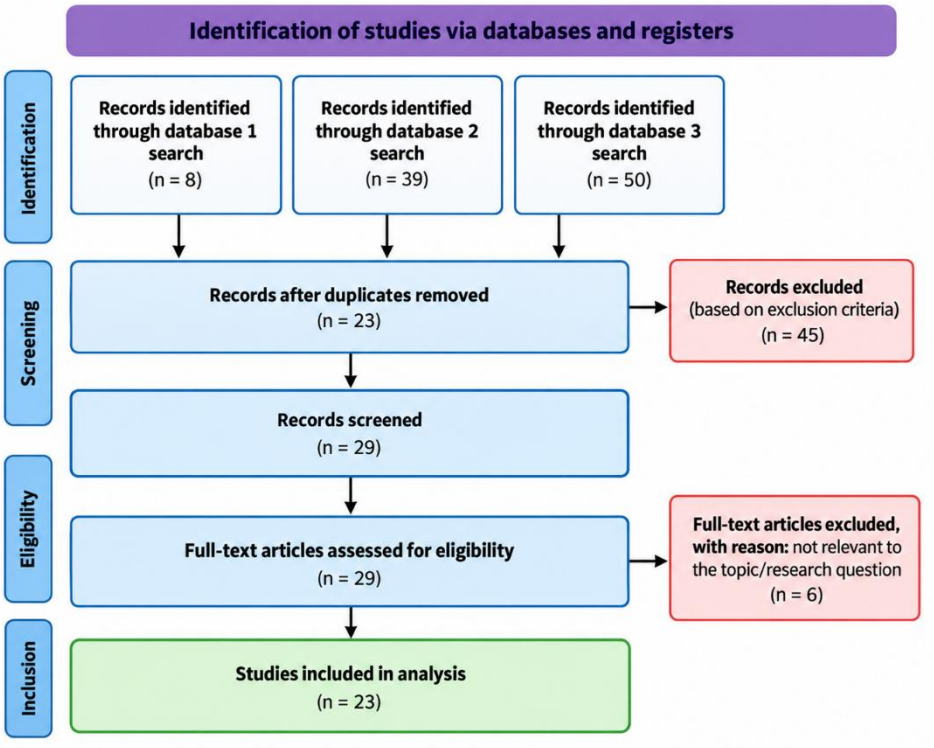


Figure 1. PRISMA Flow Diagram

3. Results and Discussion

The finding are organized according to the study focus and derived from the analyzed of 23 selected articles. To provide a clearer picture, the results are grouped into several key aspects including mathematics topics, education levels, research methods, purposes of using pop-up books, and research outcomes. The results are displayed in tables and figures to enhance clarity, followed by a critical discussion highlighting key patterns and insight emerging from the analysis.

3.1. Mathematics Topics

Based on the analysis of the 23 articles, the distribution of mathematics topics utilizing pop-up books is presented in Table 2.

Table 2. Number of Articles by Mathematics Topics

Topics	Frequency
Numbers:	
a. Whole number operations	1
b. Fractions	1
c. Exponents	1
Geometry:	
a. Plane figures	11
b. Solid figures	4
c. Plane and solid figures	1
Arithmetic	1
Unspecified	3

Based on the analysis of 23 articles, it was found that the most researched topics were in the area of Geometry, with a particular dominance of studies on plane figures. The findings indicate that, in addition to plane figures, pop-up books were also applied to solid figures. For instance, the study by Habibi and Setyaningtyas (2021) highlights that the use of pop-up books can support teachers in presenting solid geometry topics more effectively. In addition, the media provides a new perspective for integrating mathematics learning and supporting the development of learning media that better meet students' needs.

Pop-up book can be integrated into various topics within the mathematics curriculum. In addition to geometry, several studies have explored their application in area such as number theory and arithmetic. Within geometry, most research focuses on two-dimensional and three-dimensional shapes. For two-dimensional topics, discussion generally focus on measurements related to shapes like triangles and quadrilaterals, while three-dimensional topics tend to emphasize surface area and volume of polyhedra.

The dominance of geometry topics is closely related to the ability of pop-up books to support students understand geometric concepts in a more engaging and interactive manner. However, the use of pop-up books for topics beyond geometry, numbers, or arithmetic remains highly feasible, considering that pop-up books can offer a more enjoyable and meaningful learning process for students. In line with this, Setyawan as cited in Safri et al. (2017), emphasized that the main strength of pop-up book media lies in their ability to provide a unique learning experience through direct student involvement, such as manipulating elements by sliding, opening, and folding different parts of the pop-up book. These form of interaction can leave a deep impression on learners, making material is easier to remember when this medium is used.

3.2. Education Levels

The 23 articles were further grouped based on the education levels in which pop-up books were applied. The findings indicate that most studies were carried out in the elementary and junior high school levels. Specifically, 12 articles focused on elementary school, 10 articles on junior high school, and 1 article did not specify the education level.

This finding is in line with the result reported by Fitri and Karlimah (2018), who showed that pop-up books are suitable for classroom use at upper elementary students, particularly for introducing the properties of cubes and rectangular prisms, and that their application contributed to improve mathematics learning outcomes. Figure 2 presents the distribution of education levels.

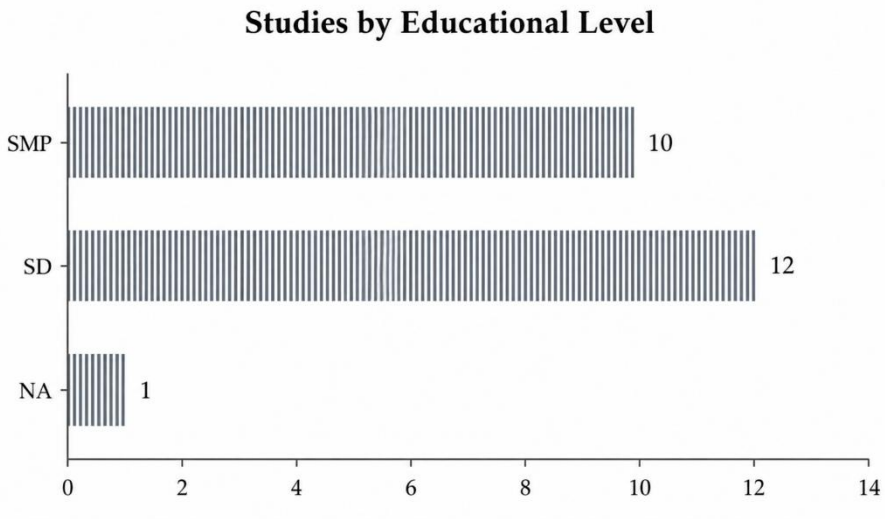


Figure 2. Studies by Educational Level

The popularity of pop-up books in elementary and junior high schools can be attributed to their engaging and enjoyable characteristics. This is supported by findings by Izzah and Setiawan (2023) who showed that pop-up books provided a more enjoyable learning experience at home. Students become more enthusiastic and motivated, reducing boredom when learning mathematics materials. According to Akina (2023), pop-up books are practical, portable, and two- and three-dimensional designs that can enhance students' learning enthusiasm. They are also flexible and can be used either individually or in groups. Therefore, the use of pop-up books is not limited to elementary and junior high levels, but has the potential to be applied across all levels from kindergarten to senior high school or vocational school. However, based on the articles that have been analyzed, no studies were found at the senior high school level. This gap provides an opportunity for future research to explore the use of pop-up books in mathematics learning at the senior level.

3.3. Research Methods

The analysis also categorized the articles by the research methods employed that can be seen in Table 3.

Table 3. Number of Articles by Research Methods

Methods	Frequency
Research and Development (R&D)	9
ADDIE Model	2
4D Model	1
Thiagarajan Model	2
Experimental	4
Classroom Action Research (CAR)	3
Qualitative	2

From the analysis of 23 articles examining pop-up books in mathematics instruction, 14 studies applied a research and development (R&D) approach, 4 used experimental design, 3 adopted classroom action research (CAR), and 2 employed qualitative methods. The dominance of R&D methods indicates a strong emphasis on developing and evaluating new instructional tools. This perspective is supported by Narahayaan et al. (2024) who highlighted the importance of developing pop-up books to enrich the variety of learning media in mathematics education.

These result suggest that existing tend to place greater attention on the development of the media itself. Bustanika & Suparman (2019) also notes that pop-up books offer several advantages, as they are easy to handle, portable, able to stimulate student's interest, and encourage more active participation. Considering these factors, it is understandable that a development oriented approach is often chosen to improve the quality and effectiveness of this media in mathematics teaching. On the other hand, alternative approach such as design research, case studies, or descriptive approaches underexplored in researching its implementation. This situation opens opportunities for further studies to apply a broader range of research approach, which could contributed to a broader understanding of the application of pop-up books in mathematics education.

3.4. Purposes of Using Pop-Up Books

In this review, the purpose of using pop-up book refers to how they function within mathematics instruction, either as supporting media in classroom activities or as structured materials designed to guide the learning activities. Based on this perspective, table 4 indicates that pop-up books are predominantly used as instructional media. Among the 23 studies analyzed, 22 classified pop-up books as learning media, while only one study examined their role as an instructional module. One study also highlight the incorporation of worksheets embedded as part of the pop-up book design.

The dominance of pop-up books as instructional media reflects their interactive and visually engaging characteristics, which are considered effective for supporting mathematics instruction. Several studies reported that pop-up books were designed to increase students' interest and involvement in classroom activities. In addition, findings from the analyzed studies consistently show a positive effect on students' motivation and learning outcomes when pop-up books were used as instructional media. Table 4 presents the detailed categorization.

Table 4 shows that the majority of studies utilized *pop-up book* as instructional media rather than as learning modules, assessment tools, or students learning resources. This finding indicates that researchers primarily view *pop-up book* as a medium to support classroom instruction and facilitate students' understanding of material concepts. The dominance of this function reflects the visual and interactive nature of *pop-up book,* which can make abstract mathematics idea more concrete and accessible to learners.

Table 4. Articles by Purpose of Pop-Up Book Utilization

No	Year of Study	Author	Use of Pop-up Book
1	2019	Muthmainnah, R N	Learning Media
2	2024	Inanda Shofa Azahroh1, Fitria Zana Kumala	Learning Media
3	2016	Indri Putri Wijayanti Sutrisno, Utari Dewi., S. Sn.,M. Pd	Learning Media
4	2024	Hikmah Bayu Angherawati, Yuli Witanto	Learning Media
5	2024	Ayuni Shakila, Eka Sastrawati, Issaura Sherly Pamela	Learning Media
6	2022	Alfi Imroatus Solikhah, dan M. Bambang Edi Siswanto	Learning Media
7	2024	Ni Kadek Dita Cahyani Dewi, I Wayan Widiana, I Nyoman Laba Jayanta	Learning Media
8	2022	Diyah Hoiriyah; Nurul Maulidia	Learning Media
9	2025	Lutfiyyah Indah Permata Sari, Ramanata Disurya, Tanzimah	Learning Media
10	2023	Lusianty Bakara , Andinasari , Nike Astiswijaya	Learning Media
11	2024	Nofa Qomara Ika Saputri , Bunga Ayu Wulandari , Indryani	Learning Media
12	2022	Jasmaniah , Nurhayati , Fatma Zuhra	Learning Media
13	2021	Fitri Andayani, Sri Adi Widodo , Denik Agustito	Learning Media
14	2023	Siti Nurazizah , Nuryami	Learning Media
15	2023	Ika Feny Nur Aini, Ni Luh Sakinah Nuraini, Yuniawatika	Learning Media
16	2021	Windi Paulina1, Neni Nadiroti Muslihah2, Risma Nuriyanti3, Ejen Jenal Mutaqin	Learning Media
17	2024	Olvi Steva Surentu[1], Philotheus E. A. Tuerah[2], Juliana Margareta Sumilat	Learning Media
18	2023	Akina1*, Dian Nitami Rukmana Paeri1, Mufidah1, Nuraini	Learning Media
19	2021	Timbul Yuwono[(1*)], Arik Dwi Indah Ningrum[(2)], Djoko Adi Susilo[(3)],	Learning Media
20	2017	Syaidatul Fitriyah	Learning Media
21	2019	Bustanika, Suparman	Learning media with worksheets inside
22	2021	Okky Wulan Dayani, Rina Agustina, Ira Vahlia	Instructional Module
23	2020	Dwi Oktaviana , Iwit Prihatin, Fahrizar	Learning Media

The widespread application of pop-up books as instructional media is closely related to their interactive characteristics and ability to attract student's attention. This is supported by Habibi and Setyaningtyas (2021), who found that the characteristics of pop-up books can stimulate students' interest and encourage greater participation during the learning process, thereby helping supporting the development of problem-solving skills. In line with this, Putri et al. (2020) emphasized that learning media should be designed in such a way as to create more engaging learning experiences, one of which can be achieved through the integration of pop-up books. In addition to increasing learning motivation, the implementation of pop-up books has also been shown to contribute positively to student learning outcomes. This is reinforced by Muslimin et al. (2023), who reported improvements in academic achievement, and further supported by Sumayana (2021) who identified positive effect on both motivation and learning outcomes.

However, beyond their role as instructional media, pop-up books can also be developed into teaching modules with worksheets, supplementary learning materials, and other educational resources. Although, among the 23 articles, only one study used a pop-up book as a teaching module, it remains possible that future research could develop pop-up books as teaching modules, worksheets, companion materials, or learning resources for students in mathematics education.

3.5 Research Findings

In this review, research findings refer to the reported outcomes of pop-up book implementation in mathematics learning, particularly in relation to students' learning outcomes, motivation, conceptual understanding, problem-solving ability, communication skills, and other mathematics-related competencies. This categorization was intended to address the fifth objective of the review, namely identifying the overall impacts of pop-up book utilization as reported in previous studies. The synthesis of findings from the 23 selected articles is presented in Table 5.

Table 5. Articles by Research Findings

No	Year of Study	Author	Research Findings
1	2019	Muthmainnah, R N	The 3D geometry pop-up book that was developed is very effective in terms of practicality and simplicity, physical design and appearance, as well as mathematical writing and content.
2	2024	Inanda Shofa Azahroh1, Fitria Zana Kumala	here is a significant difference in students' ability to understand mathematical concepts between those who use the discovery learning model assisted by pop-up books and those who use the CORE model in learning flat-sided solid figures.
3	2016	Indri Putri Wijayanti Sutrisno, Utari Dewi., S. Sn.,M. Pd	Based on the calculations, it can be concluded that this learning comic has a very good quality rating.
4	2024	Hikmah Bayu Angherayati, Yuli Witanto	The development of a pop-up book–based medium using Ahaslides is effective in improving students' understanding of three-dimensional shapes in mathematics.
5	2024	Ayuni Shakila, Eka Sastrawati, Issaura Sherly Pamela	The application of the *Make-A-Match* learning model assisted by pop-up book media can increase students' learning motivation in mathematics.
6	2022	Alfi Imroatus Solikhah, dan M. Bambang Edi Siswanto	The scores of students taught using learning media are better than those of students who are not taught with learning media.
7	2024	Ni Kadek Dita Cahyani Dewi, I Wayan Widiana, I Nyoman Laba Jayanta	he developed medium is valid and practical to use and is effective in improving problem-solving skills on the topic of integer operations for Grade-III elementary school students.
8	2022	Diyah Hoiriyah; Nurul Maulidia	Students' learning interest increased after the learning process was carried out using pop-up-book media.
9	2025	Lutfiyyah Indah Permata Sari, Ramanata Disurya, Tanzimah	The development of pop-up-book media on the topic of three-dimensional shapes for Grade-IV elementary school students falls into the category of very valid or highly feasible, very practical, and very effective, or has potential impact.
10	2023	Lusianty Bakara , Andinasari , Nike Astiswijaya	The use of pop-up-book media in mathematics learning receives positive appreciation from students.
11	2024	Nofa Qomara Ika Saputri , Bunga Ayu Wulandari , Indryani	The research proves that the application of the jigsaw-type cooperative learning model can increase the learning activity of Grade-VI students in mathematics on the topic of plane figures.
12	2022	Jasmaniah , Nurhayati , Fatma Zuhra	The problem-solving-based pop-up-book instructional media on the topic of fractions is highly feasible for use and shows that students enjoy the learning process.

No	Year of Study	Author	Research Findings
13	2021	Fitri Andayani, Sri Adi Widodo , Denik Agustito	The pop-up-book instructional media on social arithmetic is suitable for improving the achievement of students' mathematical problem-solving skills.
14	2023	Siti Nurazizah , Nuryami	The research shows that this medium—especially on the topic of three-dimensional shapes (cubes and cuboids)—can lead to an improvement in students' learning outcomes compared to before.
15	2023	Ika Feny Nur Aini, Ni Luh Sakinah Nuraini, Yuniawatika	The project-based-learning pop-up-book medium for Grade-II elementary school students on the topic of plane figures is very feasible for use.
16	2021	Windi Paulina, Neni Nadiroti Muslihah, Risma Nuriyanti, Ejen Jenal Mutaqin	It helps students learn by increasing their learning ability, especially in mathematics.
17	2024	Olvi Steva Surentu, Philotheus E. A. Tuerah, Juliana Margareta Sumilat	There is an influence of using innovative pop-up-book instructional media on students' mathematical communication skills and their interest in learning mathematics.
18	2023	Akina, Dian Nitami Rukmana Paeri1, Mufidah1, Nuraini	The application of pop-up-book instructional media in mathematics learning can improve students' learning outcomes on the topic of plane figures.
19	2021	Timbul Yuwono, Arik Dwi Indah Ningrum, Djoko Adi Susilo	The pop-up book makes it easier for students to understand the area and circumference of a circle, increases their enthusiasm for learning, and stimulates their thinking skills to simplify difficult problems.
20	2017	Syaidatul Fitriyah	There is an effect of students' activity in the PBL (Problem-Based Learning) model assisted by a pop-up book on their mathematical problem-solving ability in the topic of three-dimensional shapes.
21	2019	Bustanika, Suparman	The design of the developed pop-up book can improve students' spatial ability.
22	2021	Okky Wulan Dayani, Rina Agustina, Ira Vahlia	The module that was developed meets the criteria of being highly feasible and can be used to help students better understand the material in learning; it can also be used in the learning process as a motivation or a guide for teachers to develop modules and other teaching materials.
23	2020	Dwi Oktaviana , Iwit Prihatin, Fahrizar	The pop-up-book medium based on CTL (Contextual Teaching and Learning) can facilitate the development of junior high school students' mathematical problem-solving skills.

Based on the synthesis of the reviewed studies, the research findings consistently demonstrated that the application of pop-up books in mathematics instruction leads to positive educational outcomes. The most of studies reported improvements in students' achievement, especially in relation to conceptual understanding and problem-solving abilities. In addition, several articles also highlighted increases in students' learning motivation, interest, learning activities, and engagement when pop-up books were integrated into instruction. Moreover, a number of studies pointed the effectiveness, practicality, and feasibility of this medium, indicating that it can be appropriately applied in classroom setting. Overall, the result of this

review supports the main objective of the study by showing that pop-up books, which are mainly utilized as instructional tools, contribute positively to students' learning in mathematics.

The finding of this review are consistent with previous studies emphasizing the effectiveness of visual and interactive learning media in mathematics education. Similar results were reported by Habibi & Setyaningtyas (2021), who found that *pop-up book* increased students' engagement and participation during learning activities. Likewise, Sumayana, *et.al* (2021) and Muslimin & Imanuella (2023) reported improvement in learning outcomes and motivation following the implementation of *pop-up book-based* learning media. This similarities suggest that the positive effects of *pop-up book* have been consistently observed across different educational context and mathematical topics.

The finding suggest that pop-up books contribute to improving conceptual understanding, interest, and learning motivation, but also strengthening problem-solving abilities and overall mathematics achievement. Research in this area further shows that this medium can support the development of students' mathematical communication skills as well as their spatial abilities. These result highlights that the value of this medium in mathematics instruction, as its helps learner grasp concepts more effectively and approach problem-solving with greater confidence.

4. Conclusion

Based on an analysis of 23 studies published between 2016 and 2025, this study identified several recurring patterns related to the implementation of pop-up books in mathematics education. Most studies focused on geometry topics, particularly two-dimensional and three-dimensional shapes, and were conducted at the elementary and junior high school levels. From a methodological perspective many studies employed a developmentally oriented approach, reflecting the primary role of *pop-up book* as instructional media. In terms of their function, these materials were more often used to support teaching and learning activities rather than as standalone modules or student-generated resources. Overall, findings across the reviewed studies indicated positive contributions, including increased motivation improved achievement, stronger conceptual understanding, improved mathematical communication, and improve problem-solving skills.

Despite these encouraging results, this review also highlights an important gap, as none of the analyzed studies examined students' active participation in designing and creating pop-up books as part of the learning process. This opens up opportunities for future research to explore their integration within more student-centered approach, such as STEAM-oriented or project-based learning environments, to develop creativity and 21st-century competencies. Further investigation over a longer period would also be beneficial to understand the lasting effects of these approaches on students 'conceptual growth and attitudes toward mathematics.

Practically, the finding suggests that *pop-up book* can be considered an effective instructional medium to support mathematics learning across different educational levels. Theoretically, this review contributes to the growing body of literature on visual and interactive learning media by demonstrating the potential of *pop-up book* to support not only learning achievement but also broader mathematical competencies, including communication and problem-solving-skills.

5. Acknowledgement

I would like to thank my husband and children for their support and encouragement throughout the completion of this research. I also sincerely thank my friends and colleagues; Astri Wiliastri, Dina Wijayanti, V. Ari W, and Hadi Prayitno for their support, motivation, and meaningful discussions throughout the research process.

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