

Exploring Effective Storytelling Modalities among Teenagers in Learning Science: A Systematic Literature Review

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Abstract

This systematic literature review examines how storytelling modalities support science learning among teenagers. 14 studies published between 2021 and 2025 were analysed using PRISMA procedures. Findings show that narrative, visual, digital, performative and inquiry-based storytelling enhance scientific understanding, engagement, critical thinking, communication and science identity. Narrative and visual approaches were most common, while inquiry-guided formats showed strong disciplinary potential. Despite these benefits, research gaps persist in peer-authored storytelling, assessment tools and culturally diverse contexts. This review provides an updated synthesis clarifying effective storytelling practices for science literacy and highlights priorities for future research, including collaborative and cross-cultural storytelling interventions.

Keywords: Storytelling, Science Education, Teenage Learners, Scientific Literacy, Narrative Pedagogy

Introduction

Science education has traditionally relied on expository teaching, factual transmission and textbook-driven instruction approaches that often prioritise content coverage over meaning-making and student engagement (Rahman et al., 2025). However, this conventional model has contributed to tenacious challenges in stimulating young learners' interest in science and STEM fields, both globally and in Malaysia. Reports have shown that students frequently perceive science as difficult, abstract and disconnected from their lived experiences leading to declining enthusiasm and lower self-efficacy toward science learning (Goss et al., 2022). In Malaysia, this issue is intensified by an exam-oriented system that emphasizes habitual memorisation, leaving limited room for exploratory or creative pedagogies that support deeper conceptual understanding (Yusoff et al., 2025). As a result, many students struggle to see the relevance of science in their everyday lives, creating the need for more engaging, student-centred instructional strategies.

In the search for pedagogical approaches that can restore meaning, creativity has emerged as a critical component of effective science teaching. Creative instructional methods help students construct, represent and communicate scientific ideas more personally and

authentically. Among these methods, storytelling has gained increasing recognition as a powerful educational strategy that enhances comprehension, conceptualisation and long-term retention in science learning (Crocetti & Barr, 2020; Rowcliffe, 2004). By embedding scientific ideas within narrative elements such as characters, conflicts and plot, storytelling transforms abstract concepts into relatable, memorable experiences (Andrade, 2025; Walan & Enochsson, 2019). Story-based teaching connects emotional engagement and curiosity (Hadzigeorgiou, 2016), while research demonstrates that metaphors, analogies and narratives can brighten science lessons and increase students' interest in complex topics (Barchas-Lichtenstein et al., 2023). Storytelling also nurtures essential learning outcomes including motivation, empathy, conceptual understanding and memory retention (Fleer, 2023; Hadzigeorgiou, 2016).

Teenagers, in particular, are uniquely positioned to benefit from storytelling-based science instruction. They are immersed in rich narrative environments; from social media to digital games and they naturally use stories to make sense of the world (Dunn & Cherup, 2023; Shavkatovna & Kizi, 2020). Narrative methods align closely with adolescent literacies and ways of learning by connecting scientific ideas with personal experiences, cultural identities and informal ways of knowing (Bonds & Inwood, 2016). International studies consistently show that narrative and digital storytelling approaches increase science achievement, engagement and attitudes toward STEM (Bilici & Yilmaz, 2024; Seidel et al., 2025). They have also been shown to challenge stereotypes, enhance communication skills, and develop science identity among youth (Soares et al., 2023). Despite such evidence, storytelling remains under-practised in many science classrooms. In Malaysia, its acceptance is further hindered by rigid, content-heavy curricula, limited time and prioritisation of examinations (Jain et al. 2025).

While individual studies highlight the benefits of storytelling, there remains a significant gap in understanding how different storytelling modalities such as narrative, visual, digital, performative, and inquiry-based could specifically support scientific literacy among teenagers. Therefore, the significance of this SLR is twofold. First, it provides science educators with evidence-based insights into how storytelling can be purposefully incorporated to promote engagement, conceptual understanding and scientific literacy among adolescents. Second, it guides curriculum developers and policymakers in designing learning experiences that reflect the realities of adolescent literacies while reducing reliance on memorisation and support Malaysia's broader goals for 21st-century, inquiry-oriented science education. By synthesising what is currently known and identifying under-explored modalities, this review contributes a foundation for strengthening the role of storytelling in transforming science education for teenage learners.

Review Objectives and Rationale

To bridge this gap, this systematic literature review aims to:

1. Synthesise evidence on the relationships between teenagers' storytelling practices and development of scientific literacy.
2. Identify effective storytelling methods that leverage teenagers' literacies and enhance science learning outcomes.

Research Questions

This review is guided by the following questions:

RQ1: What storytelling modalities are currently used by teenagers in science education in general?

RQ2: Which storytelling modalities have been shown to improve teenagers' scientific understanding of science topics?

These questions provide a focused lens for analysing how different narrative forms whether textual, visual, digital, performative or inquiry-guided function within the context of teenage science learning, and how they may be effectively empowering to support meaningful instructional design.

Methodology

This systematic literature review (SLR) was conducted to examine how storytelling methods are effectively used to promote science learning among teenagers. The process followed to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure transparency, replicability and methodological consistency throughout the review process.

Research Framework

While this review was not framed by a specific theoretical model at the outset, the synthesis of findings was later interpreted through the lens of disciplinary literacy in science education, a pedagogical approach that emphasises using subject-specific language, text types and broad practices to support deeper conceptual understanding. The review also drew on principles of narrative-based learning theory which suggests that storytelling fosters engagement, meaning-making and knowledge retention by connecting new information to existing cognitive and emotional structures.

Identification

The literature search was conducted across three major academic databases which are ERIC, ScienceDirect and Scopus. These platforms were chosen as ERIC offers a comprehensive collection of education-focused research, including empirical studies, action research and policy reports. While ScienceDirect provides access to peer-reviewed journals in science, technology and educational research, ensuring high-quality, evidence-based content. Scopus, as one of the largest multi-disciplinary citation databases, includes peer-reviewed literature, conference proceedings and grey literature relevant to science education and storytelling.

These databases were selected based on their credibility, relevance to the field and ease of access. Together, they ensured a wide coverage of literature pertaining to both science education and narrative methods especially among adolescent learners. The search was conducted using keyword combinations derived from the research objectives and commonly used terms in the field. Boolean operators (AND, OR and "") were applied to expand or narrow the scope of results. The final search terms included:

- "effectiveness of storytelling in science"
- "storytelling in STEM OR Science"
- "effectiveness of narratives in science learning"

- “literature AND science education”

Initial searches returned more than 10,000 results due to overlaps with studies focusing on storytelling in ESL or language learning contexts which were outside the scope of this review. To narrow down the findings, inclusion and exclusion criteria were systematically applied.

Screening: Inclusion and Exclusion Criteria

In order to define and structure the eligibility criteria for this review, the SPIDER framework (Cooke et al., 2012) has been applied. The framework specifies the sample, phenomenon of interest, design, evaluation and research type which are relevant to the research question. Table 1 summarises the SPIDER criteria used as follows:

Table 1

SPIDER Framework of the Storytelling Modalities

SPIDER Element	Description
S (Sample)	Teenagers (13 to 21 years old)
PI (Phenomenon of Interest)	Engagement with different storytelling modalities (e.g. digital, performative, traditional, etc.)
D (Design)	Qualitative studies, mixed-methods studies, surveys, focus groups, interviews.
E (Evaluation)	Levels of engagement, motivation, participation, perceived learning outcomes
R (Research type)	Qualitative, Quantitative & mixed-method research

To determine which studies to include, this review used the SPIDER framework (Cooke et al., 2012). The *sample* consists of teenagers aged 13 to 21 years. The *phenomenon of interest* focuses on their engagement with various storytelling modalities and medium such as digital storytelling, performative approaches and traditional narratives. The *Design* includes qualitative and mixed-method studies utilising interviews, focus groups or surveys. The *Evaluation* emphasises outcomes related to engagement, motivation and learning. Finally, the *research type* comprises qualitative and mixed-method research designs. This approach ensured that the included studies provided relevant and in-depth insights into teenage storytelling engagement.

The following inclusion criteria were also established:

Table 2

The Summary of The Inclusion/Exclusion Criteria

Criteria	Inclusion	Exclusion
Publication Year	Articles published between, 2021 and 2025	Before 2021
Type of Study	Peer-reviewed empirical research (qualitative, quantitative and mixed-methods studies); action research studies included	Purely conceptual, theoretical or opinion-based studies
Language Sample	English or Bahasa Melayu	Other languages
Focus Area	Teenage learners (typically ages 13 to 21)	Early childhood, primary school students
Availability	Storytelling or narrative methods in the context of science learning only	Studies addressing advanced or unrelated STEM topics (e.g., data visualization, machine learning, economics)
	Full-text available, Open access	No full-text access; duplicate entries across databases

In total, 380 articles were initially retrieved (ScienceDirect = 203, ERIC = 156, Scopus = 21). After removal of 192 duplicates, 188 articles remained for title and abstract screening.

Screening: Data Management

The screening process was conducted manually using Microsoft Excel to organise and track article information, decision logs and exclusion rationale. Titles and abstracts were screened for relevance based on keywords, publication year and alignment with the research questions.

After the initial screening, 135 articles were excluded for irrelevance, leaving 53 articles for full-text assessment. During this stage, a further 40 studies were excluded due to:

1. Inappropriate sample groups (early childhood, primary school students) (n = 17)
2. Non-sciences (n = 7)
3. Irrelevant focus (n = 6)
4. Other research designs (n = 11)

This led to the inclusion of 2 articles. To expand the sample, manual snowballing techniques were employed, using both backward reference searches (checking references in the reviewed articles) and forward citation tracking (identifying who cited the article). This yielded an additional 2 articles, resulting in a total of 14 articles included in the final review. On the other hand, grey literature such as conference papers and institutional research reports were also considered in this review to account for developing trends and innovative practices that may not yet be widely published in indexed journals. This decision was made to ensure a comprehensive and inclusive synthesis of evidence. Besides, the purpose of this systematic review is to find out the most relevant and suitable storytelling approaches for teenagers. Therefore, grey literature could be a strong assistance in fulfilling the research objectives.

The full review process is summarised in a PRISMA-style flow diagram (Figure 1). From the initial pool of 380 articles, a final set of 14 studies met the eligibility criteria and were selected for in-depth analysis.

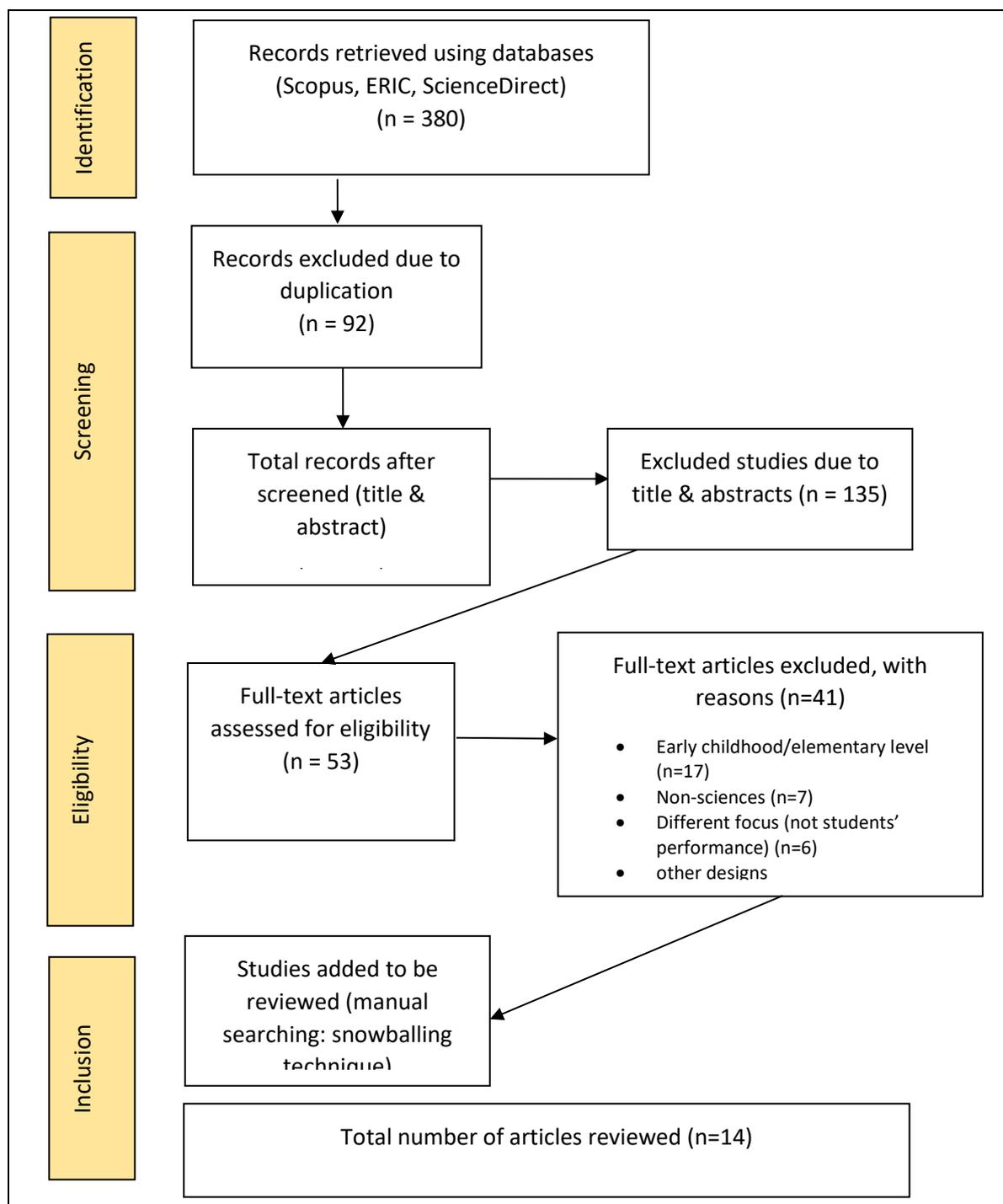


Figure 1 PRISMA Flow Diagram

The PRISMA flow diagram above outlines the systematic and transparent process undertaken to identify, screen and select relevant studies for this review. Through sequential stages of duplicate removal, title & abstract screening and full-text evaluation, only articles that met the predetermined inclusion criteria were retained. Reasons for exclusion were clearly documented to ensure methodological clarity while manual searching further

strengthened the breadth of the review. This rigorous process ultimately resulted in a final set of fourteen eligible studies, forming a credible and robust evidence base for the subsequent synthesis and discussion.

Table 3

The Table of Synthesis Matrix

No.	Article Title	Name of Authors	Year	Country	Study Design	Main Findings(s)
1	Promoting Language and Scientific Literacy Through Children's Literature	Heryani Rachmawati, Ida Muyassaroh, Dwi Heryanto, Muhamad Somantri, Euis Mulyasari, Evi Rakhmawati, Mahdi Salimi	2024	Indonesia	Systematic literature review	Children's literature supports language and science literacy, fosters interdisciplinary teaching, improves comprehension and critical thinking.
2	The effects of a story-telling approach on sixth-grade pupils' values, attitudes and motivation	Hatice Sali, Mehmet Aydan	2023	Turkey	Pre-post experimental	Storytelling improved values and attitudes but did not significantly change motivation; promoted responsibility and cultural values.
3	The effects of using collaborative digital storytelling on academic achievement and skill development	Sema Bilici, Ramazan Mert Yilmaz	2024	Turkey	Quasi-experimental	Digital storytelling improved academic achievement, critical thinking, co-regulation, narrative skills.
4	Outcomes of a 4-H STEM Learning Enrichment Program Using Video Storytelling	Diane Seidel, Michael Staffen, Lamis Abdallah, Xavier Morin	2025	USA (New Jersey)	Mixed-method evaluation	Increased confidence, science communication skills and engagement among underserved youth.
5	Digital Storytelling as a Tool for Global Citizenship and Sustainability	Suniti Modi, Tanya Gupta, Md. Rahmatullah	2024	India & Bangladesh	Systematic literature review	Enhances global citizenship, empathy, sustainability awareness and supports SDG educational goals.

6	Exploring Complex Concepts Through Storytelling in an Online Health Policy Course	Genevieve Whitmore, Jennifer Schild	2022	USA (Alaska)	Case study	Improved engagement, self-efficacy and sense of professional community.
7	An Overview of Digital Storytelling Studies in Classroom Education in Turkey	Gaisen Ispir, Yaksel Yildiz	2023	Turkey	Systematic review	Digital storytelling improves cognitive, affective, social, technological and psychomotor skills; tools identified.
8	Embedding Digital Data Storytelling in Introductory Data Science Course	Jian Chen, Jiajia Chen, Edward Wegman, Charles Osgood	2023	USA (Maryland)	Mixed methods	Improved sustainability awareness, communication and meaningful data application.
9	Digital Storytelling: Developing 21st Century Skills in Science Education	Mehmet Gursoy	2021	Turkey	Mixed methods	Strengthened 21st-century skills and creative thinking; perceived as meaningful but time-intensive.
10	Using Robots with Storytelling and Drama Activities in Science Education	Karina Bravo, Claudia Hurtado, Natalia Gonzalez	2021	Colombia	Case report	Robots with storytelling increased understanding of science, motivation and collaboration.
11	The practice of visual storytelling in STEM: Influence on creative self-efficacy and motivation	Tsai-Yun Mou	2024	Taiwan	Experimental study	Improved creative thinking and self-efficacy, no significant effect on motivation.
12	Education and public outreach: communicating science through storytelling	Geetha Tirumalai	2024	USA	Descriptive reflective account	Storytelling engages and informs public understanding of science; fosters curiosity.

13	Telling tales: the use of narratives in informal STEM settings	Noah Shaby, Caitlin Green, Heather Toomey Zimmerman	2025	Multi-country	Qualitative synthesis	Narratives enhance engagement, sense-making, and memory; design conjectures proposed for informal learning spaces.
14	How do teachers use comics to promote engagement, equity, and diversity in science classrooms?	Camillia Matuk, Talia Hurwich, Amy Spiegel, Judy Diamond	2021	USA	Qualitative study	Comics support engagement, equity and diversity by connecting to students' interests, integrating literacies, encouraging participation.

Following the PRISMA screening, 14 studies met all inclusion criteria and were included in the final synthesis. Table 3 summarises their key characteristics, diverse methodologies and participants from middle-school to undergraduate levels. Collectively, the studies show that various storytelling approaches such as digital, narrative, data-driven and drama-based enhance science learning by strengthening engagement, scientific literacy, critical thinking, communication and conceptual understanding. These 14 studies establish the core evidence base for this review.

Results

Overview of Study Settings and Methodological Designs

This systematic literature review analysed 14 articles (2021-2025) examining how storytelling methods influence science learning and student engagement. Using descriptive analysis and thematic synthesis, the review identifies patterns across study designs, participant profiles, storytelling modalities and reported learning outcomes.

Of the 14 articles, 10 explicitly focused on secondary-level contexts, targeting adolescents or offering insights applicable to teenage learners (Matuk, 2021; Shaby et al., 2025; Bravo, 2021; Chen et al., 2023; Gursoy, 2021; Sali & Aydan, 2023; Seidel et al., 2025; Bilici & Yilmaz, 2024), spanning classroom environments, extracurricular science programs and informal learning settings such as escape rooms and science exhibits.

Table 4

Overview of Disciplinary Domains, Education Levels, Sample Size & Types of Studies

Disciplinary Domain	Sample size <30	Sample Size >30	Secondary education	Higher education	Empirical studies	Non-empirical
Science & Language		1, 10, 12, 14	1, 14	1, 10, 12	10, 12, 14	1
STEM education		9	9	9		9
Biology	2, 4	3	2, 3, 4		2, 3, 4	
Cross-disciplinary	13		5, 7, 13	5, 7		5, 7
Health	6			6	6	
ICT & technology	8	11	11	8	8, 11	

Meanwhile, 8 studies examined higher education contexts involving pre-service teachers or undergraduates (Modi & Rahmatullah, 2024; Mou, 2024; Heryani et al., 2024; Ispir & Yildiz, 2023; Tirumalai, 2024). Although not centred on adolescents, these works developed pedagogical strategies highly transferable to secondary science teaching, reinforcing storytelling as an adaptable instructional approach across educational levels.

Two studies (Matuk, 2021; Shaby et al., 2025) were situated in informal STEM settings such as museums yet still engaged teenage learners, offering valuable insights into engagement and science identity through narrative-rich experiences.

All included studies employed empirical methods with varying degrees of rigour. 13 adopted qualitative or mixed-method designs using observations, interviews, artifact analysis and reflective writing (Mou, 2024; Chen et al., 2023; Seidel et al., 2025). Seven utilised pre/post-intervention designs which include quasi-experimental or one-group studies assessing critical thinking, engagement, achievement or attitudes (Gursoy, 2021; Sali & Aydan, 2023; Tirumalai, 2024). Several studies enhanced methodological robustness by triangulating self-report data with analysis of student-produced narratives and digital artifacts (Bravo, 2021; Ispir & Yildiz, 2023).

Identifying The Storytelling Modalities

Though not all studies included control groups or longitudinal tracking, the diversity of designs provided triangulated insights into how storytelling works cognitively, emotionally and socially in the context of science learning.

Table 5

The Storytelling Modality Details

Studies	Narrative storytelling	Performative storytelling	Digital storytelling	Visual storytelling	Personal Science Narrative	Inquiry-Based
<i>Heryani et al. 2024</i>	/	/	/	/	/	/
<i>Sali and Aydan 2023</i>	/	-		/	/	/
<i>Bilici and Yilmaz 2024</i>	/	-	/	/	/	/
<i>Seidel et al. 2025</i>	/	-	/	/	/	/
<i>Modi et al. 2024</i>	/	-	/	/	/	/
<i>Whitmore & Schild 2022</i>	/	-	/	/	/	/
<i>Ispir and Yildiz 2023</i>	/	/	/	/	/	/
<i>Chen et al. 2023</i>	/	-	/	/	/	/
<i>Gursoy 2021</i>	/	-	/	/	/	/
<i>Bravo et al. 2021</i>	/	/	-	/	/	/
<i>Mou 2024</i>	/	-	-	/	partially	/
<i>Tirumalai 2024</i>	/	/	-	/	/	partially
<i>Shaby et al. 2025</i>	/	/	/	/	/	/
<i>Matuk et al. 2021</i>	/	-	-	/	/	partially

All 14 studies employed narrative storytelling as a core instructional tool, but the modality and pedagogical function varied widely. The analysis categorised storytelling into six key types:

Table 6

Summary of the Storytelling Modalities

Storytelling Modality	No. of Studies	Representative Studies
Narrative storytelling	14	All studies
Visual storytelling	14	Bilici & Yilmaz, Gursoy, Bravo, Mou
Personal science narrative	13	Sali & Aydın, Chen et al., Seidel et al.
Inquiry-based storytelling	12	Bravo, Matuk
Digital storytelling	9	Heryani et al., Seidel et al., Ispir & Yildiz
Performative storytelling	5	Shaby et al., Seidel et al., Chen et al.

Based on table 6, narrative storytelling appeared in all studies as a central tool for structuring and expressing science concepts, including science-themed fiction integrating ethical dilemmas. Visual storytelling was equally common, using comics and concept maps (Mou, 2024), robot-drama props (Chen et al., 2023) and illustrated narratives (Gursoy, 2021) to increase clarity and engagement. Digital storytelling was used in seven studies, ranging from full multimedia authoring (Heryani et al., 2024; Bravo, 2021) to simpler voice-over slideshows (Seidel et al., 2025). Performative forms like robot acting (Chen et al., 2023) and role-play (Shaby et al., 2025) generated strong emotional and collaborative engagement. While personal narratives appeared across all studies, linking science to learners' lived experiences (Seidel et al., 2025; Modi & Rahmatullah, 2024).

Discussion

This review of 14 studies on storytelling in science education highlights storytelling as a multidimensional pedagogical strategy that strengthens scientific understanding, engagement and reflective thinking among learners.

Storytelling for Disciplinary Understanding

Across the literature, storytelling consistently supported the construction and explanation of scientific ideas. Students who created narratives around complex topics (Bilici & Yilmaz, 2024; Gursoy, 2021) showed improved retention, conceptual clarity and creativity. Studies embedding storytelling within inquiry-based tasks (Matuk, 2021; Seidel et al., 2025; Bravo, 2021) further demonstrated that narratives help learners hypothesise, analyse variables and explore STEM problems through lived or imagined scenarios.

Affective and Motivational Dimensions

Storytelling strongly enhanced emotional engagement and science identity. Digital and community-rooted narratives increased confidence and personal relevance (Seidel et al., 2025; Modi & Rahmatullah, 2024), while game-based storytelling heightened motivation and empathy (Shaby et al., 2025; Matuk, 2021). However, two studies (Mou, 2024; Tirumalai, 2024) reported limited shifts in intrinsic motivation which suggest that narrative impact depends on autonomy and contextual relevance.

Multimodal and Inclusive Practices

Most studies used multimodal storytelling such as visuals, drawings, role-play, voiceovers or robotics (Chen et al., 2023), providing accessible entry points for diverse learners. Visual formats such as comics (Bravo, 2021) and illustrated narratives (Gursoy, 2021) improved clarity and expression, showing that scientific understanding can extend beyond traditional text-based discourse.

Peer-Centred and Collaborative Gaps

A distinguished gap is the limited integration of peer collaboration. Few studies incorporated co-authored narratives or peer critique (Seidel et al., 2025), despite adolescence being highly influenced by social interaction. Future work should examine how collaborative storytelling can enhance scientific dialogue and collective meaning-making.

Digital and Technological Integration

Digital storytelling appeared in 7 studies, ranging from full multimedia productions (Heryani et al., 2024; Bravo, 2021) to simple narrated slideshows. Yet several strong outcomes emerged from non-digital storytelling such as drama or visual narratives (Chen et al., 2023; Tirumalai, 2024), indicating that cognitive and affective benefits stem more from purposeful narrative design than from technological complexity.

The reviewed studies show that storytelling should be intentionally integrated into science curricula as a core pedagogical approach, especially for abstract, emotionally charged or socially relevant topics. When students create their own science narratives, they engage in deeper meaning-making that enhances conceptual understanding and communication skills. Multimodal storytelling through illustrations, performances, audio or digital media supports diverse learners and broadens paths of expression. The findings also emphasise embedding peer collaboration so students co-construct narratives, provide feedback and develop collective scientific reasoning with their peers. Overall, storytelling emerges as a transformative method that strengthens various aspects such as learners' critical thinking, empathy and certainly, their science identity. It is not merely as a content-delivery tool.

Conclusion

This review affirms storytelling as a powerful pedagogical strategy that enriches scientific understanding, communication and identity formation among learners, especially youths. When applied intentionally, storytelling encourages students to connect personally with science, engaging both emotionally and cognitively while participating as active meaning-makers as they explore various walks of sciences. It shows that the future of science education requires not only inquiry and procedural skills, yet also narrative imagination and reflective engagement. Stories that are crafted and interpreted by learners will become catalysts for curiosity, empathy and informed action that prepare future generations to direct as well as shape scientific and social challenges with grounded insights and purposes.

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