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A systematic review of artificial intelligence technologies used for story writing

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Abstract

With the digital revolution of artificial intelligence (AI) in language education, the way how people write and create stories has been transformed in recent years. Although recent studies have started to examine the roles of AI in literacy, there is a lack of systematic review to inform how it has been applied and what has been achieved in story-writing. This paper reviews the literature on the use of AI in story-writing during the last 5 years. The discussion explores the year of publication, countries of implementation, educational levels, participants and research methodology. In terms of research context, most studies were carried out in universities in the United States, and children and adult learners were the two most common participants. Most studies involved the collection and analysis of quantitative data. After that, the mechanisms of using AI for story-writing are investigated in terms of the types, approaches, and roles of AI. The pedagogies used in the learning context of AI-supported story-writing are discussed. Finally, the benefits of using AI in story-writing are pointed out. The findings show that the literature has paid most attention to learners' creativity, writing skills, presentation skills, motivation, and satisfaction. The review also suggested that human-AI collaboration could effectively improve story creation. Some studies had trained high-level AI to help students write better stories. As findings from the current body of research are not conclusive, more work is needed in exploring challenges of using AI in story-writing. Lastly, a set of limitations and recommendations for future research are summarized in this study.

Keywords Digital story writing · AI story generators · Human-AI story collaboration · AI-supported story-writing · Literature review

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1 Introduction

Technological advances in artificial intelligence (AI) have impacted the education industry and the field of language education (Chow, 2020; Crompton et al., 2022; Klimashevskaia et al., 2021; Ng et al., 2021). Empowered by machine learning algorithms, AI has attracted considerable interest from the language research community to use AI to facilitate people in translating languages (Yu, 2021), writing school essays (Liu et al., 2021), formulating story structure, scenes and logic (Hsu et al., 2019). Researchers have posited that using AI in language education has become popular in recent years and has great potential to transform how people write stories. The following discussion first outlines the potential of using AI in story-writing in terms of hypothesized benefits, and then proposes the research gap and objectives.

1.1 Using AI technologies for story-writing

Digital story-writing combines traditional and new literacy approaches to enable writing with digital technologies such as digital books, virtual reality, and artificial intelligence (Lee et al., 2022; Tanrıkulu, 2022). This requires students' creativity to develop narrative work (e.g., novels, fantasy stories, fairy tales) based on real and unreal facts. However, people have encountered various challenges when writing their digital stories. First, people lack creativity and fail to brainstorm story settings (e.g., characters, time, place), themes, attempt, and consequences, climax and resolution. Second, non-native writers lack interest in English writing due to difficulty writing grammatically correct sentences and structurally correct paragraphs (Bai et al., 2021; Watcharapunyawong & Usaha, 2013). Third, some writers may struggle with technical challenges or digital competencies and feel difficult to produce multimedia elements (e.g., graphics, animation) using digital tools (Dahlström, 2019; Takacs et al., 2015).

Thanks to the prevalence and potential of AI, AI has become an effective co-author to support story-writing that facilitates people to alleviate these problems. Nowadays, many story authoring software (e.g., Sudowriter, CoAuthor; Lee et al., 2022), story animation (e.g., Adobe Animate, Visme; Kılıçkaya, 2020), and storytelling tools (e.g., KidPad, Storyjumper; Del-Moral-Pérez et al., 2019) are empowered by AI which helps users generate suggestions to write parts of or even a whole coherent story. It helps users to produce story settings (e.g., storylines, plots, characters), analyze and generate sentences and paragraphs, and adapt to writing styles (Biermann et al., 2022; Del-Moral-Pérez et al., 2019). Writers can ask the AI to create suggestions or ideas based on specific vocabulary or phrases. We can see that AI has made a significant contribution to collaborating with human writers to generate stories, and researchers even advocate to list AI as a co-author (Transformer et al., 2020). In education, AI has its potential to collaborate with students to create stories, and help educators to teach students in language education from early childhood to university education (e.g., Karlimah et al., 2021; Tanrıkulu, 2022; Xu et al., 2019). AI story generators can automatically generate script titles, characters, scenes, and dialogues as references for writers to consider adopting in their writing (e.g., Chen & Liu, 2021; Issa & Jusoh, 2019; Suh & An, 2022). It can reduce grammatical errors and even generate sentences and paragraphs with users' inputs (Woo et al., 2022). It can

recognize writing styles, and other unique patterns through analyzing sentences, paragraphs, and overall structures throughout story writing (Issa & Jusoh, 2019; Peng et al., 2018). Overall, AI has become a new language learning trend for students to create stories, and foster their creative writing, logic, presentation, and collaboration skills (Osone et al., 2021; Yuan et al., 2022). It provides learning opportunities for students to experience intelligent writing tools and enhance their technological and AI literacies (Bai et al., 2021; Del-Moral-Pérez et al., 2019; Ng et al., 2022).

However, studies reported a number of limitations when using AI for story-writing. First, AI story generators are not error-less and may make grammatical mistakes and incoherent texts (Hsu et al., 2019). One possible reason is that AI-supported story-writing lacks an understanding of human complexities and emotions, and it tends to be overly simplistic and cannot understand sarcasm and interpret human contradictions (Lee et al., 2022). It also generates another limitation that stories created by AI may be difficult to build emotional connections with readers. On this note, there is a need to understand the mechanism behind how teachers use AI as a tool to empower students' story-writing and language learning. For example, Coenen et al. (2021) used an AI-assisted editor to enable students to create digital stories in three stages: using AI to plan the storyline, generate words and sentences based on the storyline, and rewrite the story based on its dialog system. In Ng et al., (2022)'s study, educators use a five-stage inquiry-based pedagogical cycle (orientation, conceptualization, investigation, conclusion, discussion) to empower students' writing through AI-empowered translation tools, writing tools, and image stylizers. At the same time, this can foster students' AI literacy to generate their digital stories about AI and robots to address real-life problems via the story-writing.

1.2 Research gap and aim

It is evident that AI nowadays plays an important role in story-writing. However, there is a lack of consolidated reviews on AI technologies used for story-writing. Literature gaps lie in the need for a comprehensive collection and analyses of current studies on AI technologies used for story-writing. Although there are a number of survey reviews to list the types of AI story generators, they rarely focus on exploring what and how AI has been adopted and contributed to story-writing. For example, Alhussain & Azmi (2021) surveyed the approaches used in AI story generators, including covering sources, corpora, and evaluation methods. Young et al. (2013) reviewed planning-based approaches that provide an established story setting for the reasoner of AI planning to infer storylines and finally generate completed stories. These papers introduce various approaches to help people develop AI story generators.

Therefore, a systematic review is timely to reveal the trend and research context of this research domain (Petticrew & Roberts, 2008). The first question summarizes the trends in AI technologies used for story-writing, including year of publication, countries of implementation, educational levels, participants, and research methodology are analyzed. The second question addresses the basic mechanisms in terms of types, approaches, and roles of using AI for story-writing. The third question explores the benefits of using AI technologies for story-writing. These questions advance our understanding of how students adopt different types of AI technologies in story-writing, and

provide a full picture that supports educators to use AI for story-writing. The following research questions will be address:

1. What are the trends of AI technologies for story-writing?
2. What are the types, approaches, and roles of using AI technologies for story-writing?
3. What are the benefits of using AI technologies for story-writing?

2 Methods

This review adoptes the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews guidelines (Tricco et al., 2018) to review the literature on using AI in story-writing. As shown in Fig. 1, this review involved four main steps: (1) identification, (2) screening, (3) eligibility, and (4) inclusion. The PRISMA criteria was adopted because it is a scientific and systematic approach suitable for this systematic review. The open and detailed reports of the review process ensure the quality of the research, as they allow readers to evaluate the implementation of the research and its credibility while establishing the study's replication.

2.1 Search terms and process

First, the following terms were searched in the abstract: "AI" OR "artificial intelligence" AND "story writing" in the Web of Science, ERIC (Education Resources Information

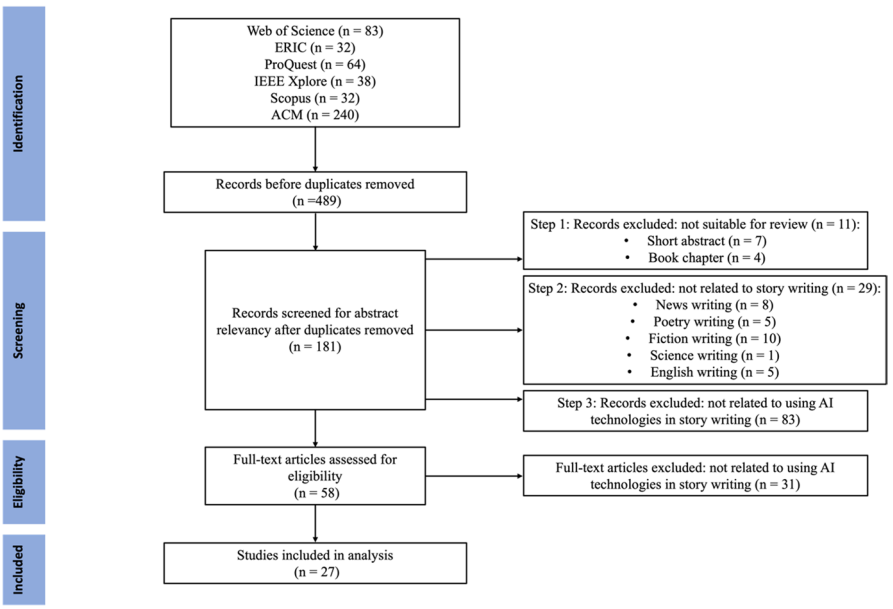

Fig. 1 The selection procedure of reviewed studies

Centre), ProQuest, IEEE Xplore, and Scopus. Almost all databases generated related articles based on the search terms except IEEE Xplore. To collect more results, one search term was changed from "story writing" to "story", which also did not generate results from IEEE Xplore. Thus, similar terms were searched such as "narrative" in these databases, and yet they did not generate relevant results in any of the databases except IEEE Xplore. The search suggested that there were limited articles related to the topic of AI used for story-writing. Most of the results focused on how the algorithm or technique is operated in AI technologies. However, few studies focus on what and how AI technologies have been adopted and contributed to story-writing. Alternatively, another database ACM digital library was used to continue the search. It has multiple articles covering computing and information technology and provides more literature relevant to this study. The same set of key terms mentioned above were used. Overall, a total of 489 articles were found in the six databases.

2.2 Include and exclude criteria

Several criteria for selecting articles were identified (see Table 1). The objective of this study is to review the latest literature to understand the trends and directions of using AI in story-writing. Therefore, the publication period was limited from 1 January 2018 to 1 October 2022. Only English articles were included. A total of 489 studies were found. All types of publications, such as journal articles, conference papers, working papers, review articles, and conceptual articles were initially included. However, short abstracts (e.g., Gagliano et al., 2021) only briefly presented their research, and book chapters (e.g., Herrera-González et al., 2020) could not be downloaded from the databases. Thus, these two types of publications were excluded. Moreover, topics related to news writing (e.g., Wang, 2021), poetry writing (e.g., Li & Zhang, 2020), fiction writing (e.g., Candello et al., 2019), science writing (Gero et al., 2022),

Table 1 Aspects of inclusion/exclusion criteria

Aspects	Inclusion	Exclusion
Publication period & Language	• 1 January 2018 to 1 October 2022 • Written in English	
Types of publication	• Journal articles • Conference papers • Working papers • Review articles • Conceptual articles	• Short abstract • Book chapter
Topic	• Story-writing	• News writing • Poetry writing • Fiction writing • Science writing • English writing
Relevance	• Using AI technologies in story-writing/creation/generation	• Analyzing how AI technologies operate algorithms to generate stories

and English writing (e.g., Chang et al., 2021) by using AI technologies were excluded since they do not address the research questions (RQs). Then, the abstract and full text of each article were browsed to ensure their relevance. The articles should focus on story-writing/creation/generation using AI technologies instead of analyzing how AI technologies operate algorithms to generate stories (e.g., Lin & Chang, 2022; Valls-Vargas et al., 2014). A total of 27 articles were thoroughly reviewed in this research (see Fig. 1). All articles were downloaded and saved on the researchers' computers.

2.3 Analysis process

The analysis process involved extraction, coding, and synthesis of data. For RQ1, relevant information was extracted and coded based on a review protocol (see Appendix). The first and second authors had regular meetings during the review process to ensure the reliability of the thematic analysis to identify the trends and patterns of using AI in story-writing. For example, educational levels were grouped into preschool and primary education and higher education/adult education based on the age of participants. Followed by the first part of RQ2 on what types of AI technologies have been used for story-writing, the names of AI technologies were identified by reviewing the studies and categorized them based on the functions of AI technologies used for story-writing. The second part of RQ2 on what approaches of AI technologies have been applied for story-writing and the third part on what roles AI technologies play in story-writing were categorized based on Alhussain and Azmi's (2021) article about the approaches of AI story generators. Lastly, for RQ3, the benefits of using AI technologies for story-writing were investigated. After collecting and organizing the data, a thematic analysis approach was used to create and evaluate implications and insights for discussions (Braun & Clarke, 2006). Thematic analysis is a popular data analysis method used to help people interpret collected data easily via inductive themes. It includes six stages: becoming familiar with the data and finding prospective things of interest, creating preliminary codes, looking for themes, evaluating probable themes, identifying and categorizing themes, and generating the text (Braun & Clarke, 2006, 2012). After rounds of discussions between the authors, consensus was reached after comparing their notes on each category in order to maintain academic rigor.

3 Results

3.1 What are the trends of AI technologies for story-writing? (RQ1)

As Tables 2 and 3 show, the trends of using AI in story-writing are sorted into five indicators of research, including year of publication, countries of implementation, educational levels, participants, and research methodology.

Table 2 Year of publication and countries of implementation

Year of publication	Number of articles	Percentage
2022	6	22%
2021	9	33%
2020	4	15%
2019	3	11%
2018	5	19%
Country		
USA	10	37%
China	4	15%
Canada	4	15%
Korea	3	11%
Japan	1	4%
Italy	1	4%
Ireland	1	4%
Indonesia	1	4%
India	1	4%
Jordan	1	4%

Table 3 Educational levels, participants and research methodology

Educational level	Number of articles	Percentage
Higher education/adult education	14	52%
Preschool and primary education	4*	15%
Participant		
Human	16	59%
Human and AI objects	1	4%
Research methodology		
Quantitative	8	30%
Mixed methods	6	22%
Qualitative	5	19%

Remarks: A study can have more than one educational level.

Year of publication There is a noteworthy trend of using AI in story-writing. It is an overall increase in the number of articles published during the last 5 years, although there is a slight decrease in 2019. Interestingly, 55% (n=15) of the studies have been published in 2022 or 2021. The results shown are collected until October 2022, and the number of articles is postulated to increase according to the curve.

Countries of implementation The researchers in the USA conducted the most studies (n=10) in using AI technologies for story-writing. Following were origins which recorded more than one publication, including China (n=4), Canada (n=4), and Korea (n=3). Only one article was identified in each of the remaining origins: Japan, Italy, Ireland, Indonesia, India, and Jordan.

Educational levels and participants Of the 27 reviewed studies, 16 (59%) employed human participants, including workers, editors, readers, writers, university students, parents, and children. There are different types of research objects reported in the reviewed studies. The majority of studies recruited humans as participants, while two studies adopted both AI agents and humans as the research objects. Seven studies did not provide relevant information and three examined students' stories as the research objects. After that, the selected articles can be categorized in two educational levels. Almost half of the reviewed studies (n = 14) were held in higher/adult education settings (divided between 4% in higher education and 48% in adult education). Four out of 27 (15%) were conducted in pre-school and primary educational level (children aged 5–8, 6–10, and 8–12 years old). The remaining eight non-empirical studies did not involve human participants and thus were not categorized in either level.

Research methodology The empirical studies (n = 19) adopted three types of research methodology. Almost a third of the studies (n = 8) adopted a quantitative research approach, including questionnaire surveys, experiments, assessments or tests, and performance tasks. These studies adopt quantitative methods to explore students' learning performances (e.g., writing skills, creativity, motivation) and examine experimental results on improving users' story-writing products via scientific data collection methods. Although quantitative research could provide validity results by conducting rigorous experiments, the limited sampling of a phenomenon may affect its validity and authenticity (Ochieng, 2009). Six studies used a mixed-methods research approach for data collection. These studies began by collecting quantitative data through questionnaire surveys and followed these with qualitative data collection, such as interview and observation (e.g., Clark et al., 2018; Yuan et al., 2022). The mixed-methods research approach could offer a triangulation viewpoint for comprehending the research results via reporting multiple data forms (Creswell, 2012). Five studies adopted a qualitative research approach, including interviews, textual and dialogic discourse, and observation. Although the qualitative research approach is beneficial for explaining the key concepts and theory development and testing, it may not be entirely generalizable (Cohen et al., 2002).

3.2 What are the types, approaches, and roles of using AI technologies for story-writing? (RQ2)

To understand the mechanisms of using AI for story-writing, it is valuable to explore the types, approaches, and roles of AI used for story-writing.

3.2.1 What are the types of using AI technologies for story-writing? (Sub-question 1)

Three types of AI technologies were identified, including story-writing collaborative agents, storytelling agents, and story animated agents (see Table 4). The results were based on the functions of AI technologies used in the story-writing process, which could be explicitly stated or implied in the selected studies (e.g., a writer and a dialog system collaborate to write a story, Coenen et al., 2021).

Twenty one studies adopted AI technologies as story-writing collaborative agents. The agents are used to help people generate stories through providing following sentences and storyline ideas. Of these studies, four studies used two AI technologies,

Table 4 Types of AI technologies used in selected studies

Types of AI technologies	Number of articles	Percentage	Studies
Story-writing collaborative agents	**21**	**78%**	
Wordcraft (an AI-assisted editor)	2		Coenen et al. (2021); Yuan et al. (2022)
StoryDrawer	2		Zhang et al. (2021); Zhang et al. (2022)
Creative Help	1		Roemmele et al., (2018)
BunCho (an AI-supported story co-creation system)	1		Osone et al. (2021)
CodeToon (generative conversational AI)	1		Suh and An (2022)
AI planner	1		Cheong et al. (2018)
Tangible coding	1		Noceti et al. (2020)
AI agent	1		Nichols et al. (2021)
An analyze-to-generate story framework	1		Peng et al. (2018)
MEGATRON-CNTRL (a novel framework)	1		Xu et al. (2020)
Intelligent narrative story creation systems	1		Park and Park (2018)
An encoder-decoder architecture	1		Gala et al. (2021)
Markov chain model (a model that hires statistics in determining a sequence of elements according to certain rules or history)	1		Issa and Jusoh (2019)
Voice assistant	1		Cambre et al. (2020)
Machine in the loop systems	1		Clark et al. (2018)
AI-writers	1		Biermann et al. (2022)
TaleBrush	1		Chung et al. (2022)
CoAuthor	1		Lee et al. (2022)
A neural narrative generation system	1		Goldfarb-Tarrant et al. (2019)
Storytelling agents	**3**	**11%**	
State-of-the-art visual storytelling models	1		Hsu et al. (2019)
SAGA (an asynchronous collaborative storytelling system)	1		Shakeri et al. (2021)
A multi-modal storytelling system	1		Wicke and Veale (2021)
Story animated agents	**3**	**11%**	
Motion comic storyboard	1		Karlimah et al. (2021)
An application of AI interactive storytelling in animation	1		Zhang (2020)
Visual story writer model	1		Min et al. (2021)

meaning that every two studies used the same tool. Specifically, Coenen et al. (2021) and Yuan et al. (2022) adopted *Wordcraft* to collaborate with writers to create stories by responding to their custom requests via open-ended conversation and expressing them in natural language. Other two studies utilized *StoryDrawer* to help children present stories via picture forms (Zhang et al., 2021, 2022). The remaining 17 studies adopted different AI technologies in each study, including AI story-writing software (e.g., CoAuthor) and AI story generator systems (i.e., intelligent narrative story creation systems). The story-writing collaborative agents are beneficial to help participants improve their stories' quality, creativity, and writing skills via inspiring their thoughts and providing completed story scenes.

Three studies used storytelling agents to help children express their story thoughts in a visual and audio way. For example, Wicke and Veale (2021) used a multi-model storytelling tool to present the story after children collaborated with robots to develop stories based on their emotions and gestures. The storytelling agents are useful to improve young children's motivation, oral, creativity, and related-story skills (Zhang et al., 2022).

Three studies adopted story animated agents to help users create story animated products by recognizing written stories with established story contexts (e.g., characters, forms, storylines). For example, Karlimah et al. (2021) used an animated storytelling tool to transfer written stories into motion comics. Zhang (2020) adopted an AI system to display storylines through incorporating interactive 3D animated elements (e.g., characteristics, scenarios). The story's animated agents promoted people's interaction with AI and increased their AI skills by practicing AI knowledge (Ng et al., 2021).

3.2.2 What are the approaches of using AI technologies for story-writing? (Sub-question 2)

Table 5 shows a summary of the approaches of AI technologies adopted in the reviewed studies. Of which, 26 reported the approaches of AI technologies used for story-writing. Alhussain and Azmi (2021)'s classification on approaches was adopted to classify the data into two main categories: (1) Planning-based models, including goal-directed approaches (i.e., the simulation approach, the global-schema approach, and the multi-agent approach) and analogy-based approach. The definition of planning-based models refers to "*In general, generating stories using AI planning works by providing an initial state and a goal for a reasoner that infer actions and ultimately lead the initial state to the story goal*." (Alhussain & Azmi, 2021, p. 6). (2) Machine learning models, including script learning and generation, story completion, and story generation. The description of machine learning models is "*Looking at a story as a sequence of events, ML learns the conditional probability distribution between story events from a story corpus. The work in this field can be categorized as follows: 1. Script learning and generation: A system learns to predict missing script events based on other events of the script. 2. Story completion: A system learns to generate the missing event based on other story events. 3. Story generation: A system in which the system generates the complete story.*" (Alhussain & Azmi, 2021, p. 10). Example frameworks of the goal-directed approach, the analogy-based approach, and machine learning story generation are shown in Fig. 2, 3 and 4.

37% (10 of 27) of the studies used planning-based models in terms of goal-directed approaches. Among goal-directed approaches, there are three types of sub-approaches,

Table 5 Approaches of AI technologies applied in selected studies

Approaches of AI technologies	Number of articles	Percentage	Studies
1. Planning-based models	**10**	**37%**	
1.1 Goal-directed approaches	**10**	**37%**	
1.1.1 Simulation approach	1	4%	
A conditional language model	1		Peng et al. (2018)
1.1.2 Global-schema approach	1	4%	
Natural language generation	1		Issa and Jusoh (2019)
1.1.3 Multi-agent approach	8	30%	
Scéalability storytelling framework	1		Wicke and Veale (2021)
Human-centered computer (supported storytelling system)	1		Hsu et al. (2019)
UnrealTM game engine	1		Zhang (2020)
Drawing applications, animation applications, and project export applications	1		Karlimah et al. (2021)
Unity game engine	1		Park and Park (2018)
Mimesis system (a communication channel among sub-modules)	1		Cheong et al. (2018)
A co-creative agent	1		Zhang et al. (2021)
A context-based voice agent and two AI-driven collaborative strategies	1		Zhang et al. (2022)
2. Machine learning models	**16**	**60%**	
2.1 Script learning and generation	**2**	**7%**	
Triangle language	1		Noceti et al. (2020)
A conditional language model implemented with LSTMs	1		Goldfarb-Tarrant et al. (2019)
2.2 Story completion	**5**	**19%**	
GPT-2	1		Osone et al. (2021)
GPT-Neo	1		Chung et al. (2022)
GPT-3	3		Lee et al. (2022); Shakeri et al (2021); Suh and An (2022)
2.3 Story generation	**9**	**33%**	
(Large-scale) neural language models	5		Biermann et al. (2022); Clark et al (2018); Coenen et al. (2021); Nichols et al. (2021); Xu et al. (2020)
Recurrent neural network language model	2		Gala et al. (2021); Roemmele et al., (2018)
A recurrent neural network + An encoder-decoder model	1		Min et al. (2021)
A generative language model	1		Yuan et al. (2022)

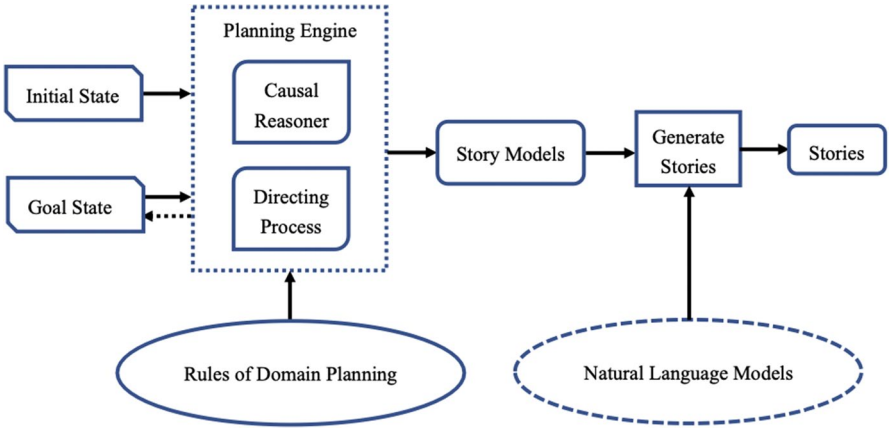

Fig. 2 The framework of goal-directed story generation (adapted from Alhussain & Azmi, 2018)

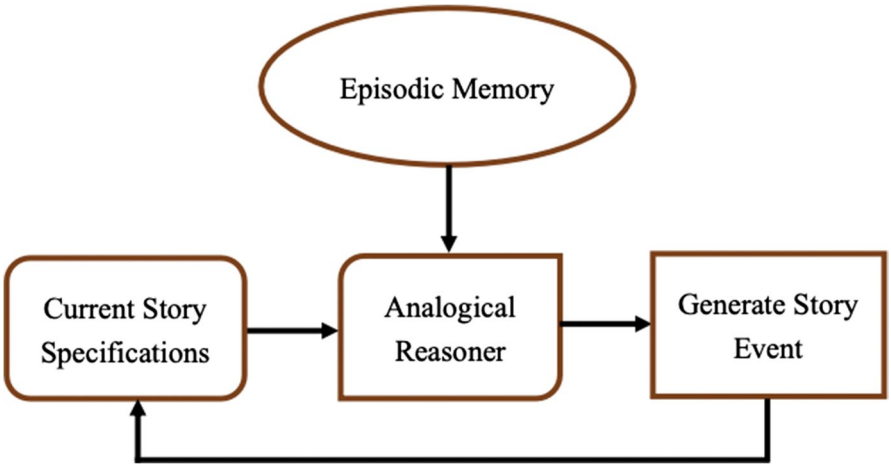

Fig. 3 The framework of analogy-based story generation (adapted from Alhussain & Azmi, 2018)

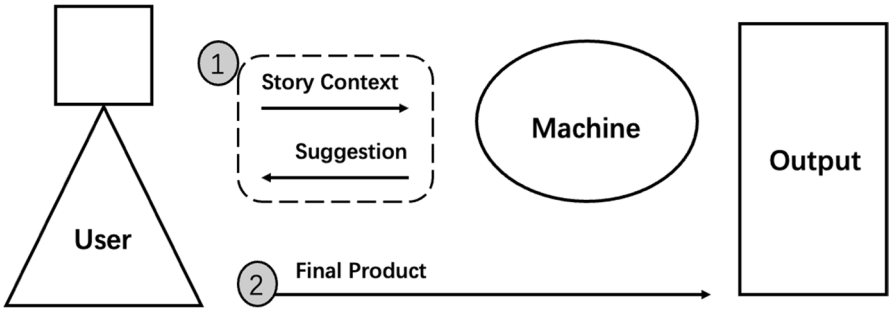

Fig. 4 A framework of machine learning story generation (adapted from Clark et al., 2018)

including the simulation approach (n = 1), the global-schema approach (n = 1), and the multi-agent approach (n = 8). The definition of goal-directed approaches refers to "*Using the goal-based agents, which range from simple atomic problem-solving agents to structured planning agents, story planners were used in a wide range of story generators in the literature*." (Alhussain & Azmi, 2021, p. 7).

The simulation approach aims to generate stories based on specific story settings (e.g., character goals) written by users. For instance, Peng et al. (2018) presented an analyze-to-generate story framework with a conditional language model to generate new stories. The process of story generation is that an analyst first extracts control elements from already-written stories, after which a generator learns to create new stories using the control factors. The simulation approach is beneficial to generating completed stories based on established character goals.

The global-schema approach aims to help writers generate stories to achieve story goals from human perspectives. For instance, Issa and Jusoh (2019) proposed a markov chain model with natural language generation, a computational creative approach with hybrid AI methods to generate educational stories automatically. This research allows writers to set characters based on their thoughts before generating stories. Then the AI tool would generate stories with conflicts or happiness plots, which seem to imitate the writing style from human perspectives. This approach benefits AI story generators to develop stories with rich storylines from human writing perspectives.

The multi-agent approach aims to assist users in generating coherent stories based on the existing context. For example, Hsu et al. (2019) presented the disadvantages of machine-generated stories that need human editing, and then provide suggestions for future research to improve story generation systems. This research provides a way to generate good quality and understandable stories by reducing word redundancy and increasing lexical diversity. This approach advantages AI story generators to generate high-quality stories with coherence and fluency based on the existing context.

The other 60% (16 of 27) studies used machine learning models. This model is used to input computational algorithms and then train the AI machine through multiple testing until it reaches high-quality outcomes with accuracy and stability. The machine learning models can be further explained by three types: script learning and generation (n = 2), story completion (n = 5), and story generation (n = 9).

First, script learning and generation is used to generate stories using story corpora (Alhussain & Azmi, 2021). It predicts the subsequent context based on the given context. For example, Noceti et al. (2020) adopted a shape interpreter to analyze shapes in a sequence and generate a completed sentence or a story. It is a tangible coding activity incorporated with AI software modules, including shape detection, shape recognition, and text generation.

Second, story completion aims to complete the plot when given a story context, which is commonly used to generate a story ending based on previous story events (Alhussain & Azmi, 2021). For example, Suh and An (2022) presented the process of a generative conversational AI helping students create comics from codes. They used an AI software called *CodeToon*, which uses a GT3 model to generate code examples and stories.

Third, story generation is used to help users generate stories automatically based on various natural language processing (NLP) tasks (Alhussain & Azmi, 2021). For example, Gala et al. (2021) explored an encoder-decoder architecture with recurrent neural

networks to automatically generate correct grammar and meaningful stories based on selected images.

3.2.3 What are the roles of using AI technologies for story-writing? (Sub-question 3)

Almost all reviewed studies (26 of 27) fall into one of the four roles of AI technologies used for story-writing using the Alhussain and Azmi (2021)'s classification, except one which was not applicable for this classification (i.e. Cambre et al., 2020). The summary of roles of AI technologies used for story-writing is shown in Table 6. Initial categories include story completion and story generation. Story completion was replaced with story co-creator/collaborator and two more categories, i.e., story animator and storyteller, were added to better describe our data.

In almost 56% of studies (15 of 27), AI had played the role of story co-creator/collaborator. This role represents that the AI could collaborate with humans to write stories. For example, Coenen et al. (2021) adopted an AI-assisted editor named *Wordcraft* to collaborate with writers to edit their stories. Their study had three stages: the writer plans the storyline, writes some words down based on the storyline; and *Wordcraft* will help the writer rewrite the story using its dialog system.

About a third of the studies (8 of 27) used AI as the role of story generators. This role points out that the AI could help writers generate stories based on given context. For instance, Xu et al. (2020) used *MEGATRON-CNTRL* (a novel framework) to generate stories of high quality with fluency, consistency, and coherence via large-scale language models.

Using AI as the role of story animators was mentioned in two studies. This role implies that AI technologies could help people create stories in animation environments. Cheong et al. (2018) implemented an AI planner which presents the story as a 3D animation using the unity game engine. The process includes three stages: (1) the user runs the AI planner to generate a story; (2) the text realization module creates a textual description of each action in the story; and (3) the user can freely choose any character or revise scenarios to interact with the story.

Next, using AI as the role of storyteller was revealed in one study. This role aims to help users display stories in a storytelling format. Karlimah et al. (2021) recruited 25 primary four students to create a motion comic storyboard using an animated storytelling tool to write stories based on the school environment (e.g., daily activities in mathematics classrooms) and mathematics knowledge.

Lastly, one study did not use the AI application (voice assistant) as an instrument, but treated it as a story character to let participants create stories by imagining it help human's story-writing (Cambre et al., 2020).

3.3 What are the benefits of using AI technologies for story-writing? (RQ3)

The benefits of using AI technologies for story-writing are classified into two dimensions (see Table 7). The key objective mentioned in most studies was to enhance learning outcomes and facilitate interaction between human and AI technologies during the story-writing process (Lee et al., 2022; Woo et al., 2022). The

Table 6 Roles of AI technologies in selected studies

Roles of AI technologies	Number of articles	Percentage	Studies
Story co-creator/collaborator	15	56%	Biermann et al. (2022); Clark et al. (2018); Coenen et al. (2021); Goldfarb-Tarrant et al. (2019); Hsu et al. (2019); Lee et al. (2022); Nichols et al. (2021); Osone et al. (2021); Park and Park (2018); Roemmele et al. (2018); Shakeri et al. (2021); Suh and An (2022); Yuan et al. (2022); Zhang et al. (2021); Zhang et al. (2022)
Story generator	8	30%	Chung et al. (2022); Gala et al. (2021); Issa and Jusoh (2019); Min et al. (2021); Noceti et al. (2020); Peng et al. (2018); Wicke and Veale (2021); Xu et al. (2020)
Story animator	2	7%	Cheong et al. (2018); Zhang (2020)
Storyteller	1	4%	Karlimah et al. (2021)

Table 7 Benefitsof AI technologies used for story-writing

Benefits of AI technologies used for story-writing	Number of articles	Percentage	Studies
1. Learning outcomes			
1.1 Children/primary students	**4**	**15%**	
Academic outcomes—assist children's oral and drawing skills, help children develop story-related skills, improve primary students' math skills	3		Karlimah et al. (2021); Zhang et al. (2021); Zhang et al. (2022)
Cognitive outcomes—assist children's story creativity and storytelling experience	1		Zhang et al. (2022)
1.2 University students/Adults	**5**	**19%**	
Cognitive outcomes—inspire writers to generate new ideas, enhance students' creativity	2		Chung et al. (2022); Suh and An (2022)
Linguistic outcomes- assist writers in creating high-level and creative writing	2		Osone et al. (2021); Yuan et al. (2022)
Affective outcomes—improve students' learning motivation and sensemaking process	1		Suh and An (2022)
2. Interaction between human and AI technologies			
2.1 AI technologies helping human with story-writing	**24**	**89%**	
Collaborate/Interact with humans to write/generate a story	19		Chung et al. (2022); Clark et al. (2018); Coenen et al. (2021); Goldfarb-Tarrant et al. (2019); Hsu et al. (2019); Issa and Jusoh (2019); Lee et al. (2022); Min et al. (2021); Nichols et al. (2021); Noceti et al. (2020); Osone et al. (2021); Park and Park (2018); Peng et al. (2018); Roemmele et al. (2018); Shakeri et al. (2021); Suh and An (2022); Wicke and Veale (2021); Xu et al. (2020); Yuan et al. (2022)
Promote human–robot interaction development	1		Wicke and Veale (2021)
Allow distance-separated friends to asynchronously collaborate creatively	1		Shakeri et al. (2021)
Encourage the user to interact with the story by manipulating props or characters	1		Cheong et al. (2018)

Table 7 (continued)

Benefits of AI technologies used for story-writing	Number of articles	Percentage	Studies
Help writers have good productivity and complete challenging writing tasks	1		Biermann et al. (2022)
Enhance the satisfaction of users through VR in storytelling activities	1		Park and Park (2018)
2.2 Human training AI technologies to generate stories	**19**		**70%**
Generate sentences suggestions for users	5		Chung et al. (2022); Clark et al. (2018); Osone et al. (2021); Roemmele et al., (2018); Yuan et al. (2022)
Generate good-quality stories with grammatically correct, sensible, fluent, consistent, and coherent	6		Gala et al. (2021); Hsu et al. (2019); Lee et al. (2022); Nichols et al. (2021); Peng et al. (2018); Xu et al. (2020)
Generate stories automatically	5		Gala et al. (2021); Hsu et al. (2019); Issa and Jusoh (2019); Min et al. (2021); Peng et al. (2018)
Use 3D animation system to present storyline setting by human	2		Cheong et al. (2018); Zhang (2020)
Identify and recognize the shapes and then produce a fantasy sentence or a small story	1		Noceti et al. (2020)

first dimension is the benefits for learning outcomes when using AI technologies for story-writing. Four types of outcomes were identified, including affective, cognitive, academic, and linguistic. This kind of classification was used in the review studies (e.g., Ibáñez & Delgado-Kloos, 2018; Wu & Chen, 2020). Affective outcomes refer to learner attitudes, including motivation and sense of satisfaction. Cognitive outcomes refer to higher-order thinking outcomes (e.g., creativity, evaluation). Academic outcomes refer to study skills and academic performances. Linguistic outcomes refer to language skills (e.g., writing, expression).

Four out of 27 studies mentioned that AI technologies could enhance children's academic and cognitive outcomes. For example, Zhang et al. (2021) reported that children could improve their presentation skills, drawing skills, collaboration skills, and story-related skills (e.g., logic skills, creativity). These studies encouraged educators and researchers to adopt AI technologies in story-writing at preschool and primary educational levels. Five out of 27 studies reported that AI technologies could assist university students/adults in improving their affective, cognitive, and linguistic outcomes. For instance, Osone et al. (2021) argued that AI enhanced university students'/adults' creativity, writing skills, engagement, and made them enjoy the writing process more.

The second dimension is the interaction between humans and AI technologies used in story-writing, including AI technologies helping humans with writing stories and human training AI technologies to generate stories. Almost all studies (24 of 27) suggested that the AI technologies used in story-writing benefits learners in story-writing. For example, Coenen et al. (2021) mentioned that AI could collaborate effectively with humans to enhance the quality of stories. Most studies adopted AI in story-writing to help people generate new ideas by providing suggestions for the subsequent sentences. It not only assists students in writing stories effectively and conveniently but also provides benefits for improving their writing skills and creativity (e.g., Osone et al., 2021; Zhang et al., 2021).

Regarding human training AI to generate stories, 70% (19 of 27) of the studies indicated that humans successfully trained AI to generate sentences and quality stories according to users' intentions. For example, Xu et al. (2020) used a large-scale language model to generate more fluent, logical, and coherent stories with less repetition and higher diversity than the prior version of AI story generator. It helped humans generate thousands of stories simultaneously and created one new story every time one entered some keywords. Consequently, more and more story workers prefer to adopt this technology.

4 Discussion

This paper reviewed 27 articles on using AI technologies for story-writing during the last 5 years. Emphasis was placed on what and how AI technologies have been adopted and contributed to story-writing. The results of RQ1 elicited the trends in AI technologies used for story-writing (e.g., year of publication, countries of implementation, educational levels, participants, and research methodology). The results of RQ2 were consolidated into three dimensions, including types, approaches, and roles of AI technologies used for story-writing. The findings of pedagogies used in the learning

context of AI-supported story-writing were discussed. Lastly, the results of RQ3 on the benefits of using AI for story-writing were categorized into two dimensions.

4.1 The trends in AI technologies used for story-writing

Year of publication and countries of implementation From the review findings, most studies were conducted in recent years during 2021–2022. This may be evidence to explain the increasing trend of publications regarding AI technologies used for story-writing. This notion is in agreement with another study that stated there has been a rapid increase in publications on AI literacy from 2014 to 2021 (Ng et al., 2021). Also, researchers in the US were most interested in applying AI technologies in story-writing (e.g., Cambre et al., 2020; Clark et al., 2018). Followed by China, Canada, and Korea using AI technologies in human story-writing (e.g., Nichols et al., 2021; Park & Park, 2018; Zhang et al., 2022). Other countries (e.g., Indonesia, India, and Jordan) also conducted a few studies, and they may increase AI applications in the future due to technology-directed society. As Ng et al. (2021) mentioned, AI technologies have been adapted and applied in education to support human activities of study and life.

Educational levels Researchers or educators focus heavily on higher education/adult education and preschool and primary education but rarely on secondary and high schools. There are two possibilities. One may be because the search databases do not contain studies conducted in secondary schools. Another reason may be explained by different age groups having various needs from AI-supported story-writing (Alhussain & Azmi, 2021). For example, undergraduate students and adults are interested in using AI technologies to create good-quality stories with correct grammar and well-structured storylines (e.g., Gala et al., 2021; Hsu et al., 2019; Lee et al., 2022). In contrast, young children prefer to express their imagination by writing interesting and vivid stories via using AI technologies such as storytelling tools and 3D animated tools (e.g., Cheong et al., 2018; Karlimah et al., 2021; Zhang, 2020). However, it is still valuable to further explore AI technologies used for story-writing among secondary and high school students, as writing skills and creative thinking are also vital for these groups of students (Woo et al., 2022).

Participants and research methodology Regarding participants, most studies recruited human participants to investigate the effects of human-AI collaborative story-writing. The creation of AI technologies is used to collaborate with humans based on their requirements (Alhussain & Azmi, 2021; Chen et al., 2020). Therefore, it is essential to understand the user experiences of AI and use these experiences to update and enhance the functions of AI story generators. Alternatively, some researchers adopted the generated stories as the research object to evaluate the quality of these stories and then evaluated the AI story generators. Other studies applied AI objects like robots. Researchers focused on exploring the interaction between humans and robots in an interactive story-writing environment. The interactive learning environment has also been popular in educational research, as

it helps increase students' interaction and knowledge skills (Tsou & Tsai, 2022). In terms of research methodology, most of the research adopted quantitative research approaches, which provide research data directly and statistically. Few studies used qualitative research methods. Of which some studies conducted deep analyses based on theoretical or conceptual frameworks. Some studies use mixed methods for triangulation of data, which is popularly used in educational research (Creswell, 2012).

4.2 Types, approaches, roles, and pedagogies of AI technologies used for story-writing

Types of AI technologies Most studies preferred to apply story-writing collaborative agents in university students or adults' story-writing. A few studies presented stories via story animation and storytelling agents among children and primary school students. This discrepancy may be explained by the characteristics of different age groups. That is, adults tend to focus more on the efficiency and quality of the story products, while young children are more interested in the sense of experience during the writing process. Therefore, the types of AI technologies used as story-writing collaborative agents commonly appear in adult education, and story animation and storytelling agents are popular in preschool and primary education.

Approaches of AI technologies Another interesting finding was that most studies using planning-based models contribute to generating good quality AI-generated stories with diversity and coherence, which makes efforts to promote the AI story generation systems used in education and other industries. As previous literature mentioned, Alhussain and Azmi (2021) stated that the computational generation of stories imitates writers' creativity to generate stories with minimum effort and create stories based on users' intentions. Other studies showed that machine learning plays an important role in AI-supported story-writing applications, as they are the basic techniques of AI story generators, which still need to be tested and updated in the innovative IT environment. Similarly, Lee et al. (2022) mentioned that although AI was incorporated into story generators, they still have multiple aspects that need to be improved, such as language technicalities and story suggestions. Therefore, researchers should continue to develop and create advanced AI story-generation systems to help humans create stories and other writing tasks.

Roles of AI technologies According to the findings on the roles of AI technologies, researchers or educators prefer to use AI technologies as the story co-creator/collaborator or story generators to help writers complete stories more creatively and efficiently. A few researchers concentrated on incorporating advanced AI technologies (e.g., comic creation, animated creation) into the story-writing process in recent years, which play roles as the story animator and storyteller. AI technologies have played an essential role in school education and human life, which is aligned with previous literature. Ng et al. (2021) reported that AI has spread across various industries, such as science, business, and education. In education, AI provides more opportunities for students to increase their technology skills and computer

capabilities to help them gain more knowledge and experience in an AI-advanced society. They also pointed out that AI technologies make people's lives more interesting and convenient when they appear in our daily applications.

Pedagogies Based on the findings on pedagogies, most studies adopted human-AI collaborative writing pedagogy to collaborate with people to generate stories by providing sentence suggestions and idea inspiration. Moreover, a few studies have adopted technology-mediated story creation pedagogy to help users visualize stories in 3D animation or storytelling products. The above phenomena are consistent with the previous literature. Frich et al. (2019) suggested that AI technologies could improve writers' writing quality and provide good practice for their creative writing skills when they become collaborative partners with writers. Also, Park and Park (2018) mentioned that AI tools could give writers an interactive environment to display stories with visual and auditory effects.

4.3 Benefits of AI technologies used for story-writing

Learning outcomes Using AI technologies for story-writing could enhance children and university students/adults' various types of learning outcomes, including affective, cognitive, academic, and linguistic outcomes. Most studies demonstrated increases in children's motivation, creativity, presentation skills, drawing skills, knowledge learning, interpersonal, and story-related skills (e.g., Karlimah et al., 2021; Zhang et al., 2022). They also contribute to improving university students' or adults' creativity, writing skills, engagement, and sense of satisfaction (e.g., Chung et al., 2022; Suh & An, 2022; Yuan et al., 2022). It is aligned with the existing literature, AI technologies benefit learning outcomes (i.e., affective, cognitive, academic, linguistic, and social) in preschool and primary education and higher/adult education (Ouyang et al., 2022; Su & Yang, 2022). The reason for increasing students' or adults' motivation and learning performances can be explained by Keller's (1984, 1987, 2009) ARCS motivational model, which has been used to evaluate learners' motivation in AI learning contexts (Lin et al., 2021). It includes four components: attention, relevance, confidence, and satisfaction. Specifically, AI technologies increase writers' attention by using the software or system's surface design which provides various functions for people to use based on their needs. The storylines and characters can be created based on writers' thoughts which are relevant to their previous knowledge. After that, writers can find writing strategies or suggestions when they have no ideas or directions, which will make them feel more confidence to handle the writing task. Finally, they will feel a good sense of satisfaction after gaining good-quality and well-structured stories with coherence and fluency. Also, many researchers (e.g., Ng & Chu, 2021; Refat et al., 2019) reported that people's motivation is positively related to their learning performance (i.e., writing performance, language knowledge) and corresponding learning skills (e.g., writing skills, creativity). Therefore, using AI technologies in story-writing could generate various positive learning outcomes.

Interaction between human and AI technologies It is interesting to find the interaction between human and AI technologies, consisting of AI technologies helping humans with writing stories and human training AI technologies to generate stories. In the aspect of AI helping humans with story-writing, most studies prefer to adopt AI tools to collaborate with users to create stories smoothly and efficiently. This development direction is aligned with previous research findings. Chen et al. (2020) mentioned that AI improves students' learning quality and experience by adjusting AI based on students' individual needs. Similar to AI used in story-writing, educators use AI to support students' writing creativity by providing suggested sentences based on their specific story context. It is also the majority goal of educators/researchers who have adopted AI technologies in their students' story-writing. During the collaborative story-writing process, students feel more enjoyable and confident, while also enhancing their motivation and engagement (Ng et al., 2021; Woo et al., 2022). Overall, this development direction is suitable for students who need additional assistance to stimulate their creativity and creative people (e.g., story writers, authors) who need to create stories but lack innovative ideas or hints. Moreover, the direction of human training AI technologies to generate stories, some studies showcased the effectiveness of AI story generators trained by humans. This development direction is aligned with the current trend of AI technologies used in other writing tasks. As Klimashevskaia et al. (2021) mentioned, people develop algorithmic journalism that could automatically generate news, referring to AI-constructed news stories. They pointed out that the AI-supported writing approach has been widely focused on and applied in many news fields, such as sports, weather, and financial reporting. Nowadays, we consider more news's effectiveness and interesting points, and relying only on human writing is hard. Therefore, good-training AI technologies would provide more opportunities for humans to empower their capabilities in writing tasks by generating paragraphs or stories. Generally, this development direction is suitable for a group of computational workers who have certain programming knowledge, people who are not good at writing, or institutes/companies that need to produce multiple writing products in a short period.

5 Conclusion

In this systematic review of AI technologies used for story-writing, we included 27 studies and investigated the trends, types, approaches, roles, pedagogies, and benefits of using AI technologies for story-writing. Our review shows a continuous interest in using AI technologies to create stories. The USA has the most interest in studying this topic in our review. The educational levels are in higher education/adult and preschool and primary education. The research objects include humans, robots, and stories. Regarding the research methodology, most studies use quantitative methods. Mix-methods are also usually used. The qualitative methods are the least. We also found that the types of AI technologies used in selected studies were story-writing collaborative agents, story animated agents and storytelling agents. In terms of approaches to AI technologies, most studies adopted planning-based models while others used machine learning models. We further found that majority

AI technologies played roles as story co-creator/collaborator and story generator, whereas seldom studies roled as story animator and storyteller. Regarding pedagogies of using AI technologies for story-writing, most studies adopted human-AI collaborative writing, while others used technology-mediated story creation.

This review further identifies two dimensions of benefits revealed by using AI technologies for story-writing. The first dimension is the benefits of using AI technologies for learning outcomes. Majority studies reported that adopting AI technologies in human story-writing increased children's motivation, creativity, presentation skills, drawing skills, knowledge learning, interpersonal, and story-related skills. They also improved university students' and adults' creativity, writing skills, engagement, and sense of satisfaction. The second dimension is the benefits of promoting interaction between human and AI technologies, including AI technologies helping humans with story-writing and human training AI technologies to generate stories. Most studies prefer to adopt AI technologies to collaborate with users to create stories smoothly and efficiently. On the contrary, some studies showcased the effectiveness of AI technologies trained by humans. It is meaningful to understand the interactive connection between human and AI technologies in this field, which promote human-AI collaborative writing and the development of AI story generators.

Last but not least, some implications for stakeholders about students' learning through writing stories with AI technologies. Firstly, educational governments and policymakers can consider formulating policies to promote AI-supported story-writing in school education. Secondly, schools can consider setting up AI-supported story-writing courses or activities to provide learning opportunities for students to exercise their creativity, writing skills, and AI knowledge. Thirdly, educators or teachers can consider incorporating AI-supported story-writing into instructional design in specific course learning (e.g., English, STEM) to promote students' writing skills, problem-solving skills, and AI literacy.

6 Limitations and recommendations for future research

Several limitations and recommendations for future research are summarized in this study. As the findings from the current body of research are based on 27 selected studies, it may not have a comprehensive understanding of this topic. Future research could search more databases (e.g., ScienceDirect) or add more other sources to extend the number of selected studies. Moreover, few studies discussed the challenges of using AI technologies for story-writing. More work is needed to clarify if AI represents an effective means to enhance learning outcomes, and what types of challenges teachers and students meet throughout story-writing. It is suggested that future empirical studies may also include the challenges of using AI technologies for story-writing for a more comprehensive understanding. Finally, there are few studies focusing on secondary school students. However, writing skills and related language learning skills in this setting are also important. More research about applying AI technologies for secondary school students' story-writing is necessary.

Appendix. Reviewed studies and information

SN	Author(s) and year of publication	Type of publication	Country	Educational level	Participant/ Research object	Methodology	Type of AI technologies	Approach of AI technologies	Role of AI technologies	Pedagogy	Benefit
1	Biermann et al. (2022)	Empirical study	Canada	Adult education	20 adults (7 hobbyists and 13 professional writers)	Qualitative	AI-writers	Modern large-scale language models	Story collaborator	Human-AI collaborative writing	Help writers have good productivity and complete challenging writing tasks
2	Cambre et al. (2020)	Empirical study	USA	Adult education	149 adults	Mixed methods	Voice assistant	No mention	No mention	No mention	No mention
3	Cheong et al. (2018)	Descriptive study	Korea	Not applicable	Not applicable	Not applicable	AI planner	The unity game engine	Story animator	Not applicable	Generate the story with humans and then visualize it as a 3D animation Encourage the user to interact with the story by manipulating props or characters

SN	Author(s) and year of publication	Type of publication	Country	Educational level	Participant/ Research object	Methodology	Type of AI technologies	Approach of AI technologies	Role of AI technologies	Pedagogy	Benefit
4	Chung et al. (2022)	Empirical study	USA	Adult education	14 adults (7 female and 7 male)	Qualitative	TaleBrush	GPT-Neo	Story generator	Human-AI collaborative writing	Collaborate with writers to generate stories based on their intentions about characters' fortune Maintain the novelty of generated sentences Inspire writers' ideas when the AI application generates stories
5	Clark et al. (2018)	Empirical study	USA	Adult education	36 adults	Mixed methods	Machine in the loop systems	A neural language model	Story co-creator	Human-AI collaborative writing	Generate suggestions based on writers' story context
6	Coenen et al. (2021)	Descriptive study	USA	Not applicable	Not applicable	Not applicable	Wordcraft (an AI-assisted editor)	Neural language generation	Story collaborator	Not applicable	Collaborate with writers to complete a story
7	Gala et al. (2021)	Empirical study	India	Adult education	No mention	Quantitative	An encoder-decoder architecture	Recurrent neural networks	Story generator	No mention	Generate grammatically correct and sensible stories automatically based on images

SN	Author(s) and year of publication	Type of publication	Country	Educational level	Participant/ Research object	Methodology	Type of AI technologies	Approach of AI technologies	Role of AI technologies	Pedagogy	Benefit
8	Goldfarb-Tarrant et al. (2019)	Empirical study	USA	Adult education	30 workers	Quantitative	A neural narrative generation system	A conditional language models implemented with LSTMs	Story co-creator	Human-AI collaborative writing	Interact with humans to generate stories
9	Hsu et al. (2019)	Empirical study	USA	Adult education	197 workers	Quantitative	State-of-the-art visual storytelling models	Human-centered computer (supported storytelling system)	Story collaborator	Human-AI collaborative writing	Assist writers in generating machine-generated visual story based on the visual storytelling model using the VIST dataset (with photos) Collaborate with users to generate good quality and understandable stories by reducing word redundancy and increasing lexical diversity

SN	Author(s) and year of publication	Type of publication	Country	Educational level	Participant/ Research object	Methodology	Type of AI technologies	Approach of AI technologies	Role of AI technologies	Pedagogy	Benefit
10	Issa and Jusoh (2019)	Descriptive study	Jordan	Not applicable	Not applicable	Not applicable	Markov chain model (a model that hires statistics in determining a sequence of elements according to certain rules or history)	Natural language generation	Story generator	Not applicable	Generate educational stories automatically based on users setting characters
11	Karlimah et al. (2021)	Empirical study	Indonesia	Primary education	25 primary students	Quantitative	Motion comic storyboard	Drawing applications, animation applications, and project export applications	Storyteller	Technology-mediated story creation	Improve primary students' math skills by developing a motion comic prototype about fractions
12	Lee et al. (2022)	Empirical study	USA	Adult education	63 writers	Quantitative	CoAuthor	GPT-3	Story collaborator	Human-AI collaborative writing	Collaborate with writers to generate stories Enhance writers' story language, ideation, and collaboration capabilities

SN	Author(s) and year of publication	Type of publication	Country	Educational level	Participant/ Research object	Methodology	Type of AI technologies	Approach of AI technologies	Role of AI technologies	Pedagogy	Benefit
13	Min et al. (2021)	Descriptive study	Korea	Not applicable	Stories from two datasets	Not applicable	Visual story writer model	Recurrent neural network structure and encoder-decoder model	Story generator	Not applicable	Generate several captions describing story contents based on the input images. These captions are then used to create a sequence of sentences to make a short story as the output
14	Nichols et al. (2021)	Empirical study	Canada	Higher education	122 adults (workers and university students)	Mixed methods	AI agent	A large-scale neural language model	Story collaborator	Human-AI collaborative writing	Assist writers in generating sufficiently human-like utterances and propose a sample-and-rank approach to improve utterance quality
15	Noceti et al. (2020)	Empirical study	Italy	Preschool and primary education	Over 1000 participants (parents and children aged 5–8)	Qualitative	Triangle coding	Triangle language	Story generator	Human-AI collaborative writing	Help an interpretation of the shapes sequence and the generation of a fantasy sentence or a small story

SN	Author(s) and year of publication	Type of publication	Country	Educational level	Participant/ Research object	Methodology	Type of AI technologies	Approach of AI technologies	Role of AI technologies	Pedagogy	Benefit
16	Osone et al. (2021)	Empirical study	Japan	Adult education	48 adults (16 writers and 32 readers)	Quantitative	BunCho (an AI supported story co-creation system)	GPT-2	Story co-creator	Human-AI collaborative writing	Assist Japanese novelists in creating high-level and creative writing, enhance affective-enjoyed writing synopses (creativity, interestingness, comprehensibility, grammatical correctness, consistency of sentences), improve common metrics-creativity, and broadened their stories
17	Park and Park (2018)	Descriptive study	Korea	Not applicable	Not applicable	Not applicable	Intelligent narrative story creation systems	Unity game engine	Story co-creator	Not applicable	Enhance the satisfaction of users through VR in storytelling activities

SN	Author(s) and year of publication	Type of publication	Country	Educational level	Participant/ Research object	Methodology	Type of AI technologies	Approach of AI technologies	Role of AI technologies	Pedagogy	Benefit
18	Peng et al. (2018)	Empirical study	USA	No mention	98,162 stories	Quantitative	An analyze-to-generate story framework	A conditional language model	Story generator	No mention	Generate stories based on control factors extracted from existing stories to reflect a user's intent Provide a good interaction environment for users
19	Roemmele et al. (2018)	Empirical study	USA	Adult education	139 adults	Quantitative	Creative Help	Recurrent neural network language model (RNN LM)	Story collaborator	Human-AI collaborative writing	Assist writers in generating more grammatical and coherent sentences, writing the story easier, influenced its content more, and were more helpful overall. The authors made significantly fewer changes to the sentence suggestions

SN	Author(s) and year of publication	Type of publication	Country	Educational level	Participant/ Research object	Methodology	Type of AI technologies	Approach of AI technologies	Role of AI technologies	Pedagogy	Benefit
20	Shakeri et al. (2021)	Empirical study	Canada	Adult education	2 adults	Qualitative	SAGA (an asynchronous collaborative storytelling system)	GPT-3	Story collaborator	Human-AI collaborative writing	Collaborate with users to generate stories based on their prompt in terms of the basis of the story, and can include things like the setting, genre of the story, and even descriptions of the characters
21	Suh and An (2022)	Descriptive study	Canada	Not applicable	Not applicable	Not applicable	CodeToon (generative conversational AI)	GPT-3	Story co-creator	Not applicable	Assist students' learning, creative, and sensemaking process in a visual programming environment where users can create comics from code Encourage out-of-the-box ideas and motivate users to participate actively in this co-creative process

SN	Author(s) and year of publication	Type of publication	Country	Educational level	Participant/ Research object	Methodology	Type of AI technologies	Approach of AI technologies	Role of AI technologies	Pedagogy	Benefit
22	Wicke and Veale (2021)	Descriptive study	Ireland	Adult education	2 robot and 1 human	Not applicable	A multimodal storytelling system	Scéalability storytelling framework	Story generator	Not applicable	Collaborate with robots to develop stories based on users' emotions and gestures
23	Xu et al. (2020)	Empirical study	China	No mention	98,161 stories	Mixed methods	MEGATRON-CNTRL (a novel framework)	Large-scale language models	Story generator	No mention	Assist writers in generating more fluent, consistent, and coherent stories with less repetition and higher diversity
24	Yuan et al. (2022)	Empirical study	USA	Adult education	25 hobbyist writers	Mixed methods	Wordcraft (an AI-assisted editor)	A generative language model	Story co-creator	Human-AI collaborative writing	Respond to writers' custom requests via open-ended conversation and express them in natural language Generate suggestions for writers in the creative process
25	Zhang (2020)	Descriptive study	China	Not applicable	Not applicable	Not applicable	An application of AI Interactive storytelling in Animation	UnrealTM game engine	Story animator	Not applicable	Use 3D animation system to present storyline setting by characteristics and scenario development

SN	Author(s) and year of publication	Type of publication	Country	Educational level	Participant/ Research object	Methodology	Type of AI technologies	Approach of AI technologies	Role of AI technologies	Pedagogy	Benefit
26	Zhang et al. (2021)	Empirical study	China	Preschool and primary education	10 children aged 5–10	Mixed methods	StoryDrawer	A co-creative agent	Story co-creator	Human-AI collaborative writing	Assist children's oral and drawing skills
27	Zhang et al. (2022)	Empirical study	China	Preschool and primary education	24 participants (12 parents and 12 Children aged 6–10)	Qualitative	StoryDrawer	A context-based voice agent and two AI-driven collaborative strategies	Story collaborator	Human-AI collaborative writing	Inspire participants' creative, elaborate ideas, and contribute to their creative outcomes during an engaging visual storytelling experience

Data availability The authors declare that the data supporting the findings of this study are available within the article and its supplementary information files.

Declarations

Conflict of interest No potential conflict of interest was reported by the author.

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