

# CHEMISTRY STORYTELLING WITH AI: A DESCRIPTIVE RESEARCH OF EBOOK CREATION FOR GRADE 10 STUDENTS

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## Abstrak

Mengajarkan senyawa kimia secara menarik itu cukup menantang karena kompleksitas materi dan sulitnya mengkontekstualisasi berbagai unsur kimia dalam kehidupan sehari-hari. Penelitian ini mengeksplorasi penggunaan alat AI dan metode bercerita untuk merancang pembelajaran kimia yang menarik bagi siswa kelas sepuluh. Penelitian ini dilakukan di Bandung Alliance Intercultural School, melibatkan lima belas siswa yang membuat ebook untuk mengajarkan senyawa kimia kepada siswa kelas dua. Data dikumpulkan melalui observasi dan penilaian rubrik. Alat AI seperti ChatGPT, Gemini, dan CanvaAI digunakan untuk mencari ide cerita, mengembangkan alur cerita, dan membuat gambar. Intervensi dari siswa diperlukan untuk memastikan kontennya sesuai usia dan menarik. Sifat kolaboratif proyek ini mendorong kepemilikan dan keterlibatan siswa. Temuan menunjukkan bahwa metode bercerita yang diperkaya dengan AI dapat membuat pelajaran kimia lebih interaktif dan relevan. Sayangnya, generalisasi hasil penelitian ini terbatas karena dilakukan di satu sekolah saja. Penelitian selanjutnya harus mereplikasi metode ini di lingkungan pendidikan yang beragam dan menggunakan desain eksperimental untuk mengukur efektivitas AI dan metode bercerita dalam pendidikan kimia.

**Kata Kunci** kecerdasan buatan; metode bercerita; pendidikan kimia; senyawa kimia

## Abstract

Teaching chemical compounds in an interesting way is quite challenging because of the complexity of the material and the difficulty of contextualizing various chemical elements in everyday life. This study explores the use of AI tools and storytelling to design engaging chemistry lessons for tenth grade students. Conducted at Bandung Alliance Intercultural School, the project involved fifteen students who created ebooks to teach chemical compounds to second graders. AI tools like ChatGPT, Gemini, and CanvaAI facilitated brainstorming, storyline development, and image generation, while human input ensured the content was age-appropriate and engaging. The collaborative nature of the project fostered student ownership and engagement. Data were collected through observations and rubric scoring. Findings indicate that AI-enhanced storytelling can make chemistry lessons more interactive and relatable. However, the study's generalizability is limited due to its single-school setting. Future research should replicate this method in diverse educational environments and use experimental designs to measure the effectiveness of AI and storytelling in chemistry education.

**Keyword:** artificial intelligence; storytelling; chemistry education; chemical compound

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## INTRODUCTION

Artificial intelligence (AI) has become increasingly ubiquitous, transforming various sectors, including education. AI applications like ChatGPT have rapidly gained popularity, amassing over 100 million users (Hu, 2023). In education, AI's influence is growing, with 47% of educational leaders reporting daily use of AI tools (Team, 2024).

Chemistry, particularly the study of chemical compounds, presents significant challenges in education. Traditional teaching methods heavily rely on memorization, which often leads to student disengagement. Students often find it difficult to see the real-world application of abstract chemical concepts, making it harder to maintain interest. Over two years of teaching chemistry, the Author 2 observed that this approach does not foster critical thinking, collaboration, or decision-making skills—key competencies for student development. Research indicates that rote learning correlates with decreased student engagement and motivation (Ma, 2022; Zhang et al., 2023). This gap in the traditional education system necessitates the exploration of more innovative and interactive teaching methods to make chemistry more approachable and interesting for students.

To address these challenges, it is essential to explore innovative teaching strategies that make learning about chemical compounds more engaging and meaningful. One such approach is integrating AI into chemistry lessons, using it as a tool to create more dynamic learning experiences. AI-powered storytelling offers a promising approach to transform the learning experience by making it more interactive and relatable. This study aims to investigate the potential of AI tools, such as ChatGPT, Canva AI, and Gemini to design engaging chemistry lessons that enhance student understanding and interest.

The incorporation of AI in chemistry education presents both opportunities and challenges. On the positive side, AI can significantly support teachers and students. AI serves as a writing assistant, boosting productivity and helping educators manage workloads more effectively. AI technologies also create personalized learning environments that align with the Zone of Proximal Development, thereby enhancing instructional effectiveness (Perna et al., 2024).

Moreover, AI is a valuable asset in distance learning, a modality that has gained prominence in recent years. AI facilitates remote education by providing robust support for teachers and students, ensuring the continuity of learning despite geographical barriers (Kılınc, 2023). Study shows that AI systems like ChatGPT can solve a considerable portion of chemistry problems (43%), highlighting their potential in complex subject areas (Daher et al., 2023).

Adaptive learning technologies driven by AI also play a crucial role in improving student performance. Research demonstrates that intelligent tutoring systems can significantly enhance learning outcomes by offering tailored feedback and support (Nja et al., 2024). Incorporating chatbot-assisted AI in chemistry education creates a dynamic, engaging learning environment that fosters greater student interest and understanding (Iyamuremye & Ndiokubwayo, 2024).

However, integrating AI into education is not without challenges. High workloads, insufficient infrastructure, and a lack of technical support pose significant barriers to effective AI implementation in schools (Wohlfart et al., 2023). Additionally, prompt engineering is necessary to ensure AI systems provide sophisticated and accurate explanations (Tassoti, 2024; Yik & Dood, 2024). AI technologies must also be adaptable to various educational contexts and consider ethical implications. While there is a generally positive perception of AI in education, its limitations in adapting to diverse settings and the need for ethical considerations remain critical issues (Almasri, 2024).

This research seeks to address the current gap in applying AI in chemistry education, particularly in the creation of educational materials. There is a need for integrating AI concepts and applications into chemistry textbooks to enhance learning outcomes (Kamal, 2024). There is also a need for visual integration in AI-enhanced chemistry lessons to make complex topics more accessible and engaging for students (Mustofa et al., 2024).

Furthermore, this research explores the use of ebooks not just as instructional media but as learning products created by students. Previous studies (Ahyar et al., 2023; Fajriah et al., 2023; Prameswari et al., 2022) have demonstrated the effectiveness of ebooks in education. This study takes it further by involving students in the creation process, thereby reinforcing their understanding of the subject matter and fostering creativity and critical thinking.

Given the potential and challenges of AI in education, this study seeks to answer the following question: How can AI tools and storytelling be leveraged to design engaging and effective chemistry lessons for Grade 10 students? Addressing this question aims to provide valuable insights into using AI to create more interactive and engaging learning experiences, ultimately enhancing students' understanding and interest in chemistry.

In summary, integrating AI in chemistry education presents promising opportunities to transform traditional teaching methods and make learning more engaging for students. However, it also introduces several challenges that need to be addressed. This research aims to explore these opportunities and challenges, providing practical solutions and insights into the effective use of AI in chemistry education. By doing so, it seeks to contribute to ongoing efforts to improve educational outcomes and foster a more dynamic and interactive learning environment for students.

## METHODS

This study uses a descriptive research design to explore AI in creating ebooks for teaching chemical compounds to Grade 10 students. The aim is to examine educational practices and teaching methods without manipulation, intervention, or testing. This research focuses on the process and key findings of AI tool integration in educational settings.

**Table 1. Lesson Plan**

<b>Title</b>	Creating an ebook on Chemical Compounds for Grade 2 Students
<b>Objectives</b>	<ul style="list-style-type: none"> <li>- Students will collaboratively create an ebook that explains chemical compounds in a simple and engaging way for second-grade students.</li> <li>- Apply knowledge of chemical compounds, formulas, and bonding to create a story.</li> <li>- Use AI tools for brainstorming ideas and enhancing content.</li> <li>- Develop communication, collaboration, creativity, and digital literacy skills.</li> </ul>
<b>NGSS Standards</b>	HS-PS1-2: Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties (NGSS Lead States, 2013).
<b>Introduction (Prerequisite)</b>	<ul style="list-style-type: none"> <li>- Review the concepts of the periodic table, ions, naming of chemical formulas, and types of chemical bonding.</li> <li>- Discuss the importance of effective communication in science and how to simplify complex ideas for younger audiences.</li> </ul>
<b>Formative Assessment</b>	<ul style="list-style-type: none"> <li>- Teacher observation of group collaboration &amp; participation during the creation process.</li> <li>- Peer review feedback.</li> <li>- Review of the closing activities and the younger students' understanding based on their responses.</li> </ul>
<b>Summative Assessment</b>	<ul style="list-style-type: none"> <li>- Evaluation of the final ebook for creativity, accuracy, &amp; appropriateness for the target audience.</li> <li>- Rubric score</li> </ul>

Fifteen 10th-grade students from Bandung Alliance Intercultural School participated in the project as part of their chemistry curriculum. Their diverse backgrounds provided a rich context for assessing the effectiveness and engagement of AI-enhanced learning activities.

Conducted over two and a half weeks (March 11-27, 2024), the study allowed students to engage in all phases of ebook creation, including brainstorming, writing, illustrating, revising, and presenting.

Data collection involved observation and rubric scoring. Author 2 continuously observed student engagement, collaboration, and the overall ebook creation process, taking detailed notes on AI tool interaction, storyline development, and illustration creation. Observations also covered group dynamics, task distribution, and student involvement in each project phase.

A detailed rubric evaluated the final ebooks, assessing creativity, chemical information accuracy, engagement level for second-grade students, and overall quality. This provided a standardized, objective method for evaluating each group's work.

**Table 2. Learning Activities**

Phase	Description	Timeline
Group Formation and Brainstorming	<ul style="list-style-type: none"> <li>- Form groups of 2-3 students.</li> <li>- Use AI tools to brainstorm ideas for the ebook story.</li> <li>- Decide on the main storyline and the three chemical compounds to be featured.</li> </ul>	Day 1
Building the Storyline	<ul style="list-style-type: none"> <li>- Outline the storyline, ensuring it is engaging and age-appropriate.</li> <li>- Plan how to seamlessly incorporate the chemical compounds and their properties into the story.</li> </ul>	Day 2
Illustration and Content Creation	<ul style="list-style-type: none"> <li>- Divide tasks within the group: writing, illustrating, and formatting.</li> <li>- Use digital tools (e.g., Canva, Google Slides) to create illustrations.</li> <li>- Write the story.</li> </ul>	Days 3-5
Collaboration and Communication	<ul style="list-style-type: none"> <li>- Review and revise the ebook as a group.</li> </ul>	Days 6-8
Peer Review	<ul style="list-style-type: none"> <li>- Groups exchange ebooks and conduct peer reviews.</li> <li>- Provide constructive feedback on clarity, engagement, accuracy, and appropriateness.</li> </ul>	Day 9
Revisions	<ul style="list-style-type: none"> <li>- Groups revise their ebooks based on the peer feedback received.</li> <li>- Make necessary adjustments to ensure the ebook is polished and ready for presentation.</li> </ul>	Day 10
Preparation for Story Time	<ul style="list-style-type: none"> <li>- Plan a 15-minute storytime session for second-grade students.</li> <li>- Create 1-3 closing activities to assess the elementary students' understanding.</li> <li>- Rehearse the storytelling.</li> </ul>	Day 12
Presentation to 2nd Grade Elementary Students	<ul style="list-style-type: none"> <li>- Present the ebooks and conduct the storytime session.</li> <li>- Facilitate closing activities and gather feedback from the elementary students.</li> </ul>	Day 13

## RESULT

In this part, authors will describe the learning process and the ebook result. The project spanned several phases, each revealing unique challenges and successes in using AI for chemistry education.

On the first day, Group Formation and Brainstorming, students had mixed reactions to the project. While some found it daunting due to its complexity, others felt intrigued and challenged. A few were surprised by the task, particularly because they had not anticipated crafting a story aimed at second graders.

The second day, Building the Storyline, brought significant challenges. Students struggled to develop a suitable storyline and use language appropriate for second graders. They frequently sought AI assistance to generate ideas, but found that the results were not always satisfactory. The teacher intervened, advising them to create more detailed prompts and critically evaluate AI-generated suggestions to better align with their goals.

Over the next 3rd-8th days – Illustration and Content Creation, Collaboration and Communication – students faced various difficulties. Some experienced exhaustion, and occasional absences due to school events, left team members feeling stuck. Despite these challenges, each student, including those with ADHD and dyslexia, actively participated and fulfilled their responsibilities. A few students even expressed a preference for a traditional test over this project due to its complexity.

During Peer Review, Revision, and Preparation for Story Time (Days 9-12), groups took turns assessing each other's e-books. One member stayed at their station to explain their e-book while others rotated, observing and providing feedback. Each group then reviewed the feedback they received, discussed its validity, and listed changes to improve their stories. The peer feedback process was constructive, with students providing fair assessments and avoiding inflated marks. Comments like "The storyline is clear" and "Your book is too long; you can shorten it" helped groups refine their e-books.

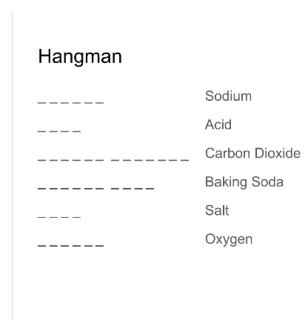
On the final day (Day 13), the second graders were mostly attentive and engaged. The Grade 10 students employed different storytelling approaches, with some dividing roles while others managed activities. A group incorporated a Q&A session to gauge understanding, which the second graders responded to positively. Feedback from the Grade 10 students was mixed but generally positive, with some expressing satisfaction with the process, while others felt the outcomes did not entirely meet their expectations. Overall, the experience was a valuable learning journey for both the older and younger students.

From this learning process, students created 5 ebooks (Nugraha, 2024c). Authors will only review 2 ebooks because they all have similar features and meet the learning objectives.



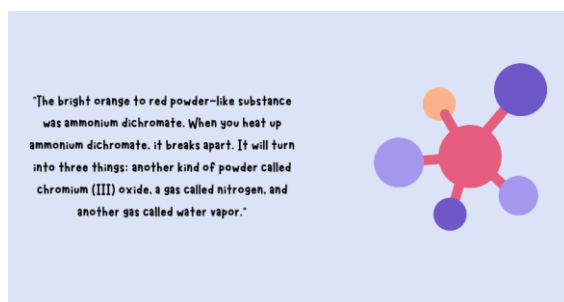
Figure 1. Explanation of Sodium hydroxide

The ebook titled “The Elementville” (Nugraha, 2024b) introduces five age-appropriate compounds—baking soda, carbon dioxide, sodium hydroxide, NaCl (salt), and HCl (hydrochloric acid)—with clear, colorful illustrations. The narrative flows smoothly, integrating the compounds’ names and properties seamlessly (Figure 1).



**Figure 2. Hangman activity**

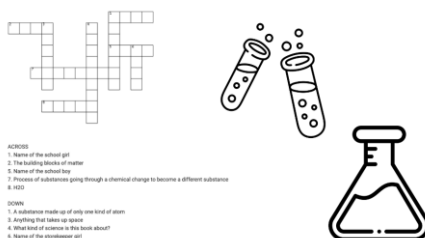
The ebook features three interactive activities: hangman, a Q&A session, & a word scramble, reinforcing learning objectives through enjoyable methods on Figure 2. Despite some absences, group members maintained excellent collaboration. The final product showcases creativity, scientific accuracy, and significant effort, resulting in a high-quality educational resource.



**Figure 3. Explanation of Ammonium dichromate**

The ebook titled “The Chem Equation” (Nugraha, 2024a) is well-illustrated and introduces basic chemistry concepts in an engaging way. However, the story sometimes struggles with pacing and clarity, and the language is advanced for young readers. Definitions of matter, mixture, and compound are not simplified, and the book is somewhat lengthy. Characters are well-developed, but explanations need further simplification. Compounds are shown more through illustrations than text (Figure 3).

The layout, resembling a comic book, may confuse the flow. Only two activities were designed and not executed on Figure 4. Unequal contributions and absence during storytime posed challenges, yet the book demonstrates creativity, accurate concepts, & considerable effort in design.



**Figure 4. Crossword activity**

**Table 3. Scoring rubric**

Criteria	Excellent (4 pts)	Good (3 pts)	Fair (2 pts)	Needs Improvement (1 pt)
<b>Engagement and Clarity</b>	Story is engaging, well-paced, and clearly explains compounds and properties. Target audience is considered.	Story is mostly engaging and explains the compounds and properties, but might lack pacing or clarity in some parts.	Story might be underdeveloped or lack clear explanations.	Story is unclear, difficult to follow, or irrelevant to the project goal.
<b>Development and Relevance</b>	Characters are well-developed, relatable to the target audience, and contribute to the story.	Characters are somewhat developed and relevant, but might lack depth or connection to the story.	Characters are underdeveloped or irrelevant to the story.	Characters are missing or not described.
<b>Variety and Integration</b>	3-5 diverse and age-appropriate compounds are chosen, well-integrated into the story, and their properties explained.	2-3 relevant compounds are chosen, somewhat integrated into the story, and properties explained.	Fewer than 2 relevant compounds are chosen, poorly integrated into the story, or properties not explained.	No compounds or irrelevant ones are chosen.
<b>Clarity and Relevance</b>	Illustrations are colorful, clear, and accurately depict characters, scenes, and compounds.	Illustrations are mostly clear, but might lack vibrancy or details.	Illustrations are unclear, poorly executed, or irrelevant to the content.	Illustrations are missing or inadequate.
<b>Engagement and Learning</b>	2-3 engaging and interactive activities are created, aligned with the target audience and effectively reinforce learning about naming compounds.	1-2 activities are created, but might lack engagement or alignment with learning goals.	Activities are missing, poorly designed, or not relevant to the project.	
<b>Group Work and Feedback</b>	Group members effectively collaborate, contribute equally, and provide constructive feedback during the project.	Group members somewhat collaborate and exchange feedback, but might lack equal participation or constructive comments.	Collaboration is minimal or ineffective, and feedback is lacking or unhelpful.	Group members do not collaborate or communicate effectively.
<b>Creativity, Accuracy, and Effort</b>	Book demonstrates creativity, accuracy in concepts, and overall effort in design and execution.	Book shows some creativity and effort, but might lack accuracy or details in some aspects.	Book is lacking in creativity, accuracy, or effort.	Book is incomplete, poorly executed, or does not meet project requirements.

*What is the characteristic of “engaging chemistry lesson”?*

## DISCUSSION

The authors assessed the ebooks using a detailed scoring rubric, as shown in Table 3. This rubric evaluated various aspects such as creativity, scientific accuracy, engagement level for the target audience (second-grade students), and the overall quality of the ebook. Each group received

feedback based on these criteria, ensuring a comprehensive and objective assessment of their work.

Engaging chemistry lessons, as defined by the authors, are those that utilize relevant context, offer content on a need-to-know basis, and make students feel that their input matters (Westbroek et al., 2005). These characteristics are critical in making the learning process interactive, meaningful, and effective for students

Utilizing relevant context in chemistry education means that concepts should be presented within scenarios that students find familiar and engaging, such as real-world applications like environmental issues or everyday products. This approach helps students see the practical relevance of chemistry in their daily lives, moving beyond the abstract theories that can often feel disconnected from their experiences. For example, rather than simply teaching chemical reactions in a vacuum, educators might present them within the context of baking or environmental pollution, allowing students to see the chemistry at play in actions they encounter daily. By situating learning within coherent and relatable narratives, students are more likely to grasp the significance of what they are learning. This approach avoids what the authors term "the rhetoric of conclusions," where students are taught outcomes without truly understanding the underlying processes or the context that gives them meaning. When chemistry is embedded in contexts that resonate with students, they develop a more profound and meaningful grasp of chemical concepts, seeing them not just as facts to memorize but as tools to understand the world around them.

Offering content on a need-to-know basis means that instead of presenting a deluge of information all at once, content should be introduced gradually and in alignment with students' evolving questions and tasks. This strategy aligns the learning process with the natural curiosity and problem-solving approach that students use when engaging with the world. For instance, rather than starting a unit with complex chemical theories, educators can introduce these theories progressively as students encounter related questions or problems. When a student is investigating why a metal rusts, this becomes the perfect moment to introduce concepts like oxidation and chemical reactions. This method ensures that learning is purposeful, allowing students to encounter new concepts precisely when they need them to understand the problem at hand. By doing so, educators create an inquiry-based learning environment that makes the acquisition of knowledge logical and relevant to the student's immediate needs, fostering deeper engagement and understanding.

Making students feel that their input matters involves appreciating their active involvement in the learning process. When students perceive that their contributions can influence the direction of the lesson, they become more engaged and invested in their learning journey. This sense of agency promotes ownership over their educational experience. Teachers can foster this environment by incorporating student input into discussions, encouraging questions, and valuing their insights during activities like presentations and peer reviews. This approach counters the traditional education model, where students are often passive recipients of knowledge. Instead, it positions them as active contributors, reinforcing the importance of their voices in shaping the learning experience and guiding the educational process.

*Where do the characteristics of "engaging chemistry lesson" appear in the learning process?*

The first characteristic, utilizing relevant context, appeared in the process of creating the storyline. Creating an appropriate storyline for second-grade students is crucial, considering their developmental stage. According to Piaget's theory, second graders are in the concrete operational stage, which means they understand best through concrete, tangible experiences (Piaget, 1964).

Therefore, the 10th-grade students needed to contextualize chemical compounds within everyday scenarios to facilitate understanding. Selecting proper chemical compounds that could be seamlessly integrated into the storyline proved challenging. Students had to choose simple chemical reactions that could be easily understood and demonstrated within the context of the story.

The second characteristic, offering content on a need-to-know basis, appeared in the process of choosing which chemical compound to be included in the storyline. To effectively integrate chemical compounds into their storylines, students needed to have a solid grasp of prerequisite concepts such as the periodic table, ions, naming of chemical formulas, and types of chemical bonding. AI tools like ChatGPT helped students understand the characteristics of chemical formulas, providing them with a foundational knowledge base from which to build their stories. This approach ensured that the content was introduced progressively and only when necessary, aligning with the need-to-know basis principle.

The third characteristic appeared in the collaborative process. The collaborative nature of the project fostered a sense of ownership and value among the students (Byusa et al., 2021). Each member's contribution was crucial to the success of the project, and the peer review process further reinforced this by allowing students to contribute to the improvement of their peers' work. Reviewers provided constructive feedback, and each group used this input to enhance their ebooks, ensuring that all members felt their contributions were valued and impactful.

*How can AI tools and storytelling be leveraged to design engaging and effective chemistry lessons for Grade 10 students?*

AI tools such as ChatGPT and Gemini were instrumental in brainstorming story ideas, developing the storyline, and generating activity ideas. Students were encouraged to use chain-of-thought prompting techniques to refine the AI-generated content (Wei et al., 2023). This method aligns with findings which suggest that digital story writing fosters AI literacy among students (Ng et al., 2022). By assessing the appropriateness and logic of the storylines generated by AI, students engaged in critical thinking and iterative refinement processes.

The collaboration between human input and AI significantly improved the story creation process. Study noted, such collaborations can effectively enhance the quality and creativity of the stories (Fang et al., 2023). Students used CanvaAI to generate images for their ebooks. While they found it challenging to create consistent characters and images aligned with their storylines, AI tools helped produce background and illustrations, allowing students to focus on character development using Canva's editing tools. The final ebooks were assembled using Canva, demonstrating a successful integration of various AI tools and human creativity.

*What should teachers do to prevent students heavily relying on AI?*

This project also addressed concerns about students' over-reliance on AI (Conley, 2024; Takerngsaksiri et al., 2024). By using multiple tools and requiring a combination of knowledge, skills, and creativity, students learned to leverage AI as an aid rather than a crutch. The diverse tools and methods employed ensured that students could not rely solely on AI; doing so would result in illogical or incomplete stories. Additionally, evaluating AI-assisted projects through various methods—such as peer reviews, rubrics, and teacher assessments—helped provide a holistic view of the students' learning outcomes and the project's effectiveness.

## CONSLUSION

This study demonstrates that AI tools and storytelling can effectively design engaging chemistry lessons for 10th-grade students. AI tools facilitate brainstorming, storyline development, comprehension of chemical compounds, and image generation for the stories. However, human input is crucial to ensure the storybooks are comprehensible and engaging for 2nd-grade students. Conducted in a single school, the study's findings may have limited generalizability. Different schools with varied demographics and resources could yield different results. Future research should replicate this method in diverse settings and employ experimental designs to rigorously measure the effectiveness of storytelling and AI in chemistry education.

## THANK YOU NOTE

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