STEAM Tales

Pedagogical guide

How to use storytelling to improve children's learning process

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STEAM Tales

Enhancing STEAM education through storytelling and hands-on learning

Pedagogical guide

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Introduction

Storytelling has been a **fundamental aspect of human communication for millennia**, with countless cultures utilising stories to **make sense of the world, create emotional connections, transmit knowledge, and spark imagination**.

In the classroom, especially for young children, it offers a dynamic and inclusive approach that **captures students' attention, boosts participation, enhances retention and fosters deeper understanding**. This approach makes complex topics more **concrete and relatable**, helping students connect emotionally with unfamiliar situations and abstract concepts.

Storytelling is a powerful pedagogical tool that **fosters curiosity, empathy and engagement** across all areas of learning. When stories focus on real-life role models who have faced challenges and helped shape the world around them, they become even more impactful, **promoting perseverance and resilience** and empowering children to **imagine and pursue their full potential**.

Stereotypes, instilled in children as early as primary school, still suggest that minorities, such as women, are less gifted in STEM, and have a negative effect on girls' interest and affinity towards STEAM fields. There is an urgent need to **draw girls into STEAM fields by boosting their confidence**, which can be achieved through dynamic pedagogical methods.

Combining interactive storytelling and hands-on activities has been shown to be particularly effective, enriching and promising, as shown by the creation and use of our STEAM Tales resources, with **lesson plans and practical experiments directly associated to the stories of 12 female role models**, tested in several European countries with a wide variety of children and educators.

This pedagogical guide will help you achieve the same goals by exploring **how storytelling can be effectively integrated into formal education**. Each chapter

provides **insights, information, examples, tips and practical strategies** for teachers to use, create and implement this approach:

- **Chapter 1** introduces the concept of storytelling as a tool for inclusive and accessible education, highlighting how it supports engagement, comprehension, empathy, diversity and various psychological processes through the Hero's Journey model.
- **Chapter 2** focuses on the creation of compelling and effective educational stories focused on relevant interactions and relatable characters, especially real-life role models, and aligning with educational goals and formatting needs.
- **Chapter 3** offers guidance on implementing storytelling in the classroom. It explores techniques for engaging delivery, encourages pupil participation, and explains how to connect stories with hands-on learning activities to strengthen concept retention, particularly useful in STEAM education.
- **Chapter 4** addresses how storytelling featuring female role models can counter pervasive gender stereotypes in STEAM fields and, together with experiential learning, boost girls' confidence and interest from an early age and how it can be incorporated into school assessment.
- **Chapter 5** provides practical strategies for aligning storytelling with curriculum goals. It includes guidance, structure, and examples to help teachers integrate stories meaningfully into various subjects, making learning more memorable, emotionally engaging, and accessible.

Altogether, the guide equips educators with the tools to **harness storytelling as a transformative teaching method that combines knowledge, emotion and imagination**.

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Chapter 1: The power of storytelling in inclusive education

1.1 The benefits of storytelling as a pedagogical tool

Storytelling enables the transmission of knowledge in a way that is **relatable, memorable and emotionally engaging**. Rather than merely presenting facts, teachers can use stories to **provide context, spark curiosity, and support retention of information**. This approach aligns with a constructivist model of learning, where learners actively build understanding through **connections with prior knowledge and experiences**.

According to the Early Childhood Education Journal, countless studies and testimonies highlight that pupils who struggle with traditional formats are **more willing to participate** when learning is framed through a story or involves a **relatable character** through which they **can experience various situations** and explore **a variety of concepts in an authentic and concrete manner**.

☆ **For example:** In a mathematics lesson on fractions, create a story about a friendly boy who runs a tiny sandwich stall at the school fair. Each customer wants their sandwich cut in a different way. Pause to ask: "Have you ever had to share something with a friend? How would you do it?" and "Would it be fair if the character cuts a sandwich into uneven parts?" Pupils can use paper sandwiches to act out the character's decisions, helping them visualise and emotionally engage with the concept of equal parts for different needs and the practical relevance of fractions in their daily lives.

This character-driven narrative allows pupils to **visualise and emotionally connect with complex STEAM concepts** as they will likely identify with the characters tailored to their age group and imagine themselves in the characters' shoes, identifying with their situation and developing a better understanding of complex topics through a more **tangible and personal approach**.

Additionally, when pupils see fictional characters navigate challenges and solve problems in the context of a story that they perceive as a tale that will likely end well, they develop **emotional resilience** and a framework for dealing with their real-life experiences. This is especially beneficial for children who may be **anxious about learning or hesitant to speak** in front of others, and especially for girls and minorities who are less likely to **feel comfortable in STEAM fields**.

> Learn more about the cognitive and emotional impact of storytelling in Chapter 2.4 and about the concept of identification in Chapter 4.2.

Moreover, storytelling promotes a **stronger teacher-pupil relationship**: when teachers allow children to get involved and interact throughout the activity, they show that **every child's background, needs and voice matter in the learning process**. This creates a classroom culture and climate filled with **trust, creativity and mutual respect**, which positively **affects motivation and academic performance** and ensures more efficient learning, especially for learners with fewer opportunities or marginalised backgrounds.

Involving children during the development and delivery of a story enhances the emotional impact of storytelling by giving them a sense of **ownership and pride** and helping them **take an active part in the learning process**.

TIPS AND TRICKS

Involve the audience in the storytelling experience: Ask pupils to take part in the progression of the story by **asking them their thoughts, feelings, hypotheses, ideas and suggestions** about the plot and characters: where they think the story is going, how they would have acted in a character's shoes, etc. They can then **use the concepts they have learned** by imagining parts of the story and **applying theory to practical situations.**

1.2 Storytelling to foster empathy, accessibility and gender inclusivity in STEAM

As exemplified by our main project resources, namely the stories focused on successful women in STEAM, storytelling is a practical and engaging way to make STEAM subjects more inclusive, especially for younger pupils or children from marginalised communities. By **featuring diverse and relatable characters**, such as **children of various backgrounds, genders, ethnicities, cultures, personalities, and socioeconomic contexts**, all achieving great things and defying conventional roles, you give all pupils the chance to **see themselves represented** and **learn tolerance and acceptance of real-life diversity**. This helps to break down gender stereotypes, among other prejudiced views, and build empathy and social skills by encouraging children to **imagine experiences different from their own** and showing them **anyone can achieve the same goals if they are given the same chances**.

This approach to storytelling is particularly valuable when the goal is to **celebrate diversity** and increase the likelihood that underrepresented students will pursue STEAM careers (Collins, 2021). Indeed, early exposure to narratives featuring female scientists can therefore play a key role in **countering harmful stereotypes** and encouraging girls to envision themselves in these careers (Buckley et al., 2021). STEAM Tales stories present 12 women from **diverse cultural, ethnic**, **historical and social backgrounds**, ensuring broad representation in STEM. This diversity enriches the educational experience by showing children that **success in STEM is not limited by gender, ethnicity, or geography**.

In doing so, it greatly encourages **empathy** by helping more privileged children **see the world through another's eyes**, imagine how others' struggles could feel and consider different viewpoints they may not have been exposed to otherwise, **enhancing their understanding of their peers and their ability to empathise with different situations and communities as they grow.**

☆ **For example:** A historical lesson could follow a young black girl living in Senegal right after the French colonisation, such as in Rose Dieng-Kuntz's story, or a Jewish girl growing up in fascist Italy, such as in Rita Levi-Montalcini's story, allowing children to explore key events, practices and figures through their eyes.

It can thus make sensitive topics, such as injustice, inequality, persecution and social classes, more approachable, and help learners understand how social issues can affect children of different eras and cultures.

TIPS AND TRICKS

- **Choose or create stories with diverse characters**: Balance the identities of the characters with **various backgrounds, genders, ethnicities, cultures, religions, socioeconomic contexts, body types, orientations, and personalities**, such as curious and independent girls or sensitive and empathetic boys, along with **characters with disabilities or learning disorders,** to ensure all children see themselves represented and **develop tolerance and open-mindedness**.
- **Include open-ended questions about children's perceptions of characters' struggles**: Ask children questions about what they think of the characters' situations related to **prejudice, judgment, stereotypes or misconceptions**. Make them **reflect on the fairness and emotional impact** of the way characters are treated or the circumstances they live in: "How would you feel if that happened to you?" or "What would you do in this situation?"
- **Emphasise shared qualities and universal traits**: Highlight relatable concepts and behaviours, such as **perseverance and curiosity**, and show how applying empathy to strangers' situations can help challenge stereotypes, defy roles and biases, and break barriers.

Additionally, inclusive education involves strategies that reach all learners, especially those with **fewer opportunities or access to STEAM education and careers**, such as girls, ethnic minorities and people with disabilities and learning disorders. Storytelling, by nature, **makes learning more accessible and engaging** regardless of one's background or means, and opens doors for **easily applied accommodations** through interactive methods.

TIPS AND TRICKS

Include physical, visual, audio and digital aids: Use **illustrations, sounds, movements and varying intonations** to accompany the story and ensure comprehension. **Ensure that all children can fully understand and participate** by applying a variety of accommodations during the creation and implementation of the activity, depending on the format you use:

- **Ensure the text size and font are accessible:** use sans-serif fonts (such as Arial or Century Gothic) of adequate size (at least 12 to 14) and adequate line-spacing (at least 1.5). Propose a large-print or braille version if needed.
- **Use clear, simple language** with short sentences and familiar vocabulary and break the content into paragraphs or sections with headings and icons.
- **Highlight key words in bold and use adequate colour contrast** across text and visuals to aid focus and ensure proper readability.
- **Use visual aids, movements and sounds** (icons, illustrated scenes, puppets, drawings, gestures, facial expressions, body language, sign language or finger spelling, sound effects) to support comprehension.
- **Provide a written version for spoken stories and an audio version for written stories:** describe visuals aloud or provide screen reader-friendly formats of digital stories, for learners with reading difficulties or visual impairments.
- **Use multisensory approaches, repetition, routines and patterns**: provide a coherent structure; combine sounds with visuals and gestures; use tactile materials like textured storyboards or raised-line illustrations.
- **Allow movement breaks or roles** that involve action (acting out parts, flipping pages or drawing elements) and make space for different modes of response (drawing or acting out a scene or character, building scenes with the children, rephrasing plot points) to maintain dynamics and attention.

- **Adapt the speed and rhythm and allow extra time** for processing or interacting with the story; slow down, add or skip interactions based on children's responses and needs, and make relevant pauses and clarifications to ensure adequate understanding.

1.3 The Hero's Journey model

All the STEAM Tales stories have been written following Joseph Campbell's "Hero's Journey" model, also called the Monomyth model, a **universal, effective and insightful framework for educational storytelling**. This structure can be adapted and applied to countless stories and **gives coherence and momentum** to narrative-based content. It involves specific goals for each stage, which result in **emotional and psychological processes** which can be observed and fostered through tailored interactions and adaptations.

The model, as we have used it for our stories, includes 12 stages:

Name of the Monomyth stage	Expected content	Psychological and emotional processes
1. The Ordinary World	○ The hero/heroine's world at the beginning of the story. ○ **Familial and social context**, personality, hobbies and interests. ○ **Motivations** for embarking on the adventure.	Personal identification through empathy with the character. Decentralisation to develop empathy.
2. The Call to Adventure	○ The challenge that the main character faces, which	Feeling of frustration, injustice and outrage with the character's situation.

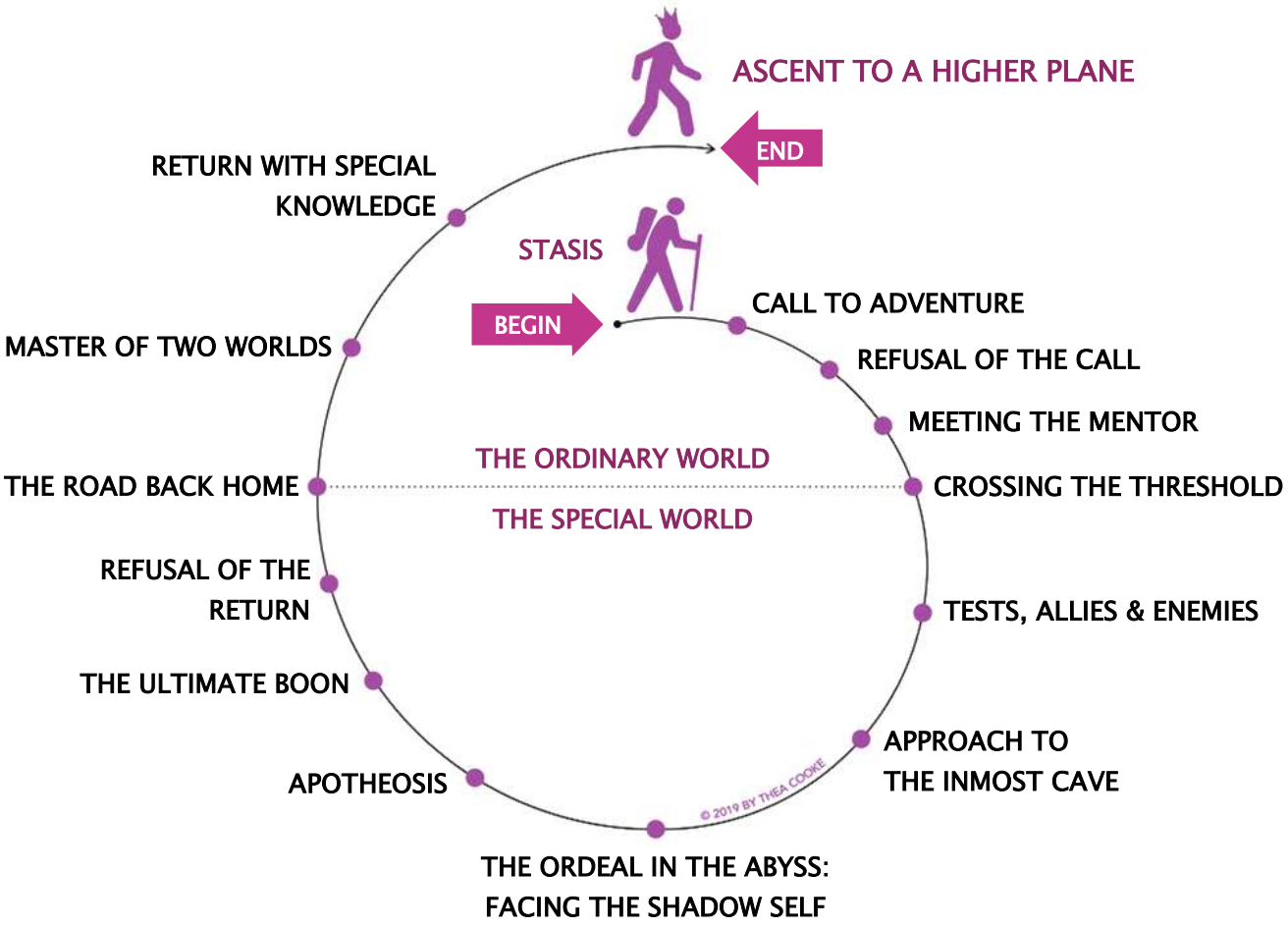
	prompts them to **step into the adventure**. ❍ Who/what is the **Herald** of their story?	Promotion of social perspective.
3. The Refusal of the Call	❍ The potential **hesitations** of the hero/heroine to go on the adventure. ❍ The reasons behind their fears and doubts.	Socio-cognitive conflict through anxiety and expectation.
4. The Meeting of the Mentor / The Supernatural Aid	❍ Who helps the hero/heroine gain **wisdom and tools**? ❍ Who is their **Mentor/Mentors**?	Identification, anxiety and expectation.
5. Crossing the Threshold	❍ The hero/heroine crossed the **point of no return** in the story. ❍ Appearance of a **Threshold Guardian** (character or challenge) to overcome to start the adventure. ❍ The challenges reflect **common childhood fears or obstacles.**	Doubt, excitement, and anticipation for the rest of the story and what will happen.
6. The Belly of the Whale	❍ The depiction of the **unknown world** the hero/heroine enters.	Identification with the character.

	❍ The **doubts, fears and struggles** of the main character in an unfamiliar situation.	Projection of the fear of falling. Promotion of fear, anxiety and social perspective.
7. The Road of Trials, Meeting with the Goddess, and Temptation	❍ The variety of **tests, challenges, struggles and obstacles** that the hero/heroine faces and overcomes. ❍ Does the character try and fail? What do they do when they fail? ❍ Potential **allies, friends, obstacles and enemies**.	Rollercoaster of emotions: Promotion of happiness and excitement, then frustration and anger, then renewed hope and enthusiasm. Promotion of collaborative thinking.
8. The Atonement with the Father and the Apostasis	❍ The story reaches a **turning point**. ❍ How does this moment become a **positive and empowering experience**?	Promotion of happiness and motivation.
9. The Ultimate Boon	❍ The hero/heroine receives a **reward**. ❍ The reward is **relatable and achievable** by the audience.	Feelings of happiness, reward, and recognition.
10. The Refusal of Return and the Magic Flight	❍ The hero/heroine attempts to **return to their normal life**.	Promotion of doubt and anticipation.

	❍ Can add any unexpected **twists or challenges** to captivate readers.	
11. The Rescue from Without	❍ The **final test**, resulting in an ultimate **transformation and achievement**.	Promotion of doubt and anticipation, leading to a feeling of excitement and happiness.
12. Crossing the Return Threshold, the Master of Two Worlds and the Freedom to Live	❍ The new **knowledge or wisdom** that the hero/heroine brings back with them. ❍ The **message that the story conveys** to the audience, such as overcoming challenges or internal growth.	Promotes feelings of great happiness and excitement.

When exploring the STEAM Tales stories of each female role model, you can easily spot how **each chapter corresponds to one of the stages of the Monomyth model** and understand how that progression has been applied to elicit certain reactions from children, along with interactions and questions which reinforce the psychological and emotional aims of each step of the activity. Knowing this progression and its impact can help you understand **how to efficiently create or adapt your own stories** and which elements to include, and when, to ensure an adequate and engaging story and meet the cognitive and emotional goals you've set for the activity.

Note that other versions exist of the Hero's Journey framework, with differences in the stage numbers, names and specifics, but with similar aims and progression, such as this one, adapted from Academy of Life Planning:



☆ **For example:** A geography story could follow a young explorer faced with a volcanic eruption. As the character overcomes various challenges, meeting allies and enemies, pupils learn about tectonic plates, safety measures, and environmental impact in an engaging way, understanding the value of these concepts and how they can shape the world they live in.

Chapter 2: Framework for creating effective educational stories

2.1 Compelling educational stories

Egan (1986) highlights that framing lessons as stories significantly enhances both comprehension and retention, as **narrative provides a natural framework** for organising knowledge. An educational **narrative should follow a clear structure** to help children process information in a logical and meaningful way.

- **Beginning**: Introduce the setting, context, and characters.
- **Middle**: Present a challenge, turning point, or journey.
- **End**: Offer resolution, reflection, or a takeaway message and empowering outcome.

In the case of **biographical stories**, a **chronological approach** is particularly effective. STEAM Tales stories begin with the role model's childhood, which enables children to connect emotionally and personally with the character, seeing that she was once just like them. The conclusion is meant to be **uplifting or thought-provoking**, leaving children with a sense of empowerment or purpose. Once the story concludes, the narrator offers additional insights into the life of the role model, including key biographical details and perhaps an authentic photograph of her. This transition allows the role model to be recognised as a real, tangible individual.

You can further read about the narrative model (the Hero's Journey) used to structure the STEAM Tales stories in Chapter 1.3. This section applies that structure to storytelling in the classroom.

Challenges make narratives more engaging by **mirroring real-life problem-solving** (Bruner, 1991). **Identification** with characters can boost engagement and motivation (Murphy et al., 2011), especially when learners can **relate to the challenges and aspirations** of the protagonist. Characters based on real-life role models, with both human flaws and strengths, stimulate empathy, emotional engagement and feel more meaningful. **Emotions** enhance memory retention and motivation. If a story evokes an emotional response (such as curiosity, hope, injustice, or wonder), it will have a more lasting impact.

More information about the phenomenon of identification can be found in Chapter 4.2.

To increase effectiveness and engagement, educational stories should stimulate children's thinking by asking **questions** and encouraging **discussion**. In STEAM Tales stories, the narrative flow is interrupted at strategic points to ask children questions and prompt reflection on the storyline and the main characters' decisions. This helps children build a connection with the characters and deepen their understanding of the characters' motivations. Discussing stories also helps children develop critical thinking skills.

The purpose of the STEAM Tales stories is not only to share the inspiring journeys of women in STEM but also to introduce children to key **scientific concepts** relevant to each role model's work. To support this goal, the narratives are enriched with **brief sections that explain** technical terms or scientific ideas, making them more accessible to children. As Egan (1986) highlights, connecting new knowledge to storytelling can significantly enhance children's understanding.

Follow-up activities, such as hands-on experiments, further enhance the understanding of scientific concepts related to the work or role models. Each STEAM Tales story is accompanied by two **hands-on experiments** directly linked to the story's protagonist, designed to further enhance the development of STEM knowledge and skills.

> Chapter 3.4 addresses the combination of hands-on activities with storytelling. More information can also be found in Chapter 4.4.

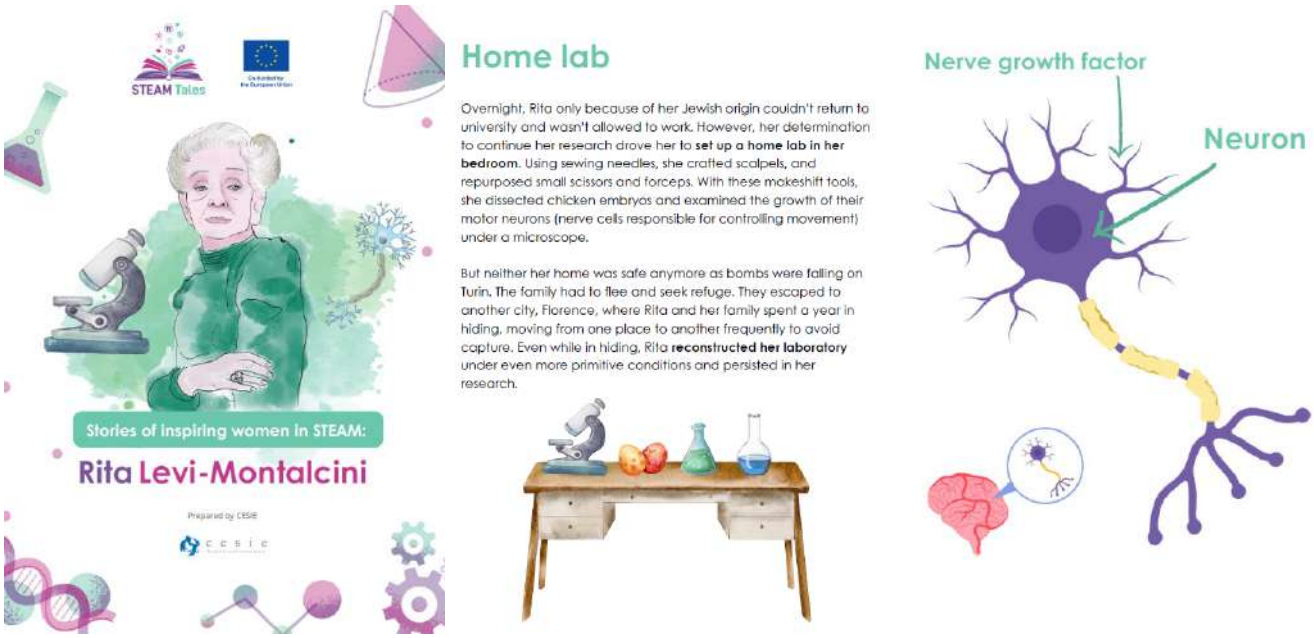
Language is a key element in crafting effective educational stories. Using **age-appropriate vocabulary** along with vivid, sensory-rich descriptions makes the story both engaging and accessible to young learners. Also, the narrative voice shapes the reader's experience (Bruner, 2004).

A **first-person** narrative fosters a stronger emotional connection by allowing readers to step directly into the protagonist's shoes. However, this approach may sometimes create a disconnect between the narrator and the audience. For example, a story about a female scientist told in the first person by a male teacher might feel inauthentic, potentially disrupting the story's impact and authenticity.

In contrast, a **third-person** narrative offers a more flexible and inclusive perspective (Bruner, 2004). It allows us to observe characters from the outside, more objectively analyse human motivations, social dilemmas, and consequences, which is key to developing empathy and critical thinking.

Furthermore, incorporating **diverse cultural narratives** through third-person storytelling can expand children's understanding of different lived experiences, promoting inclusivity and cultural awareness in the classroom.

Visual elements such as illustrations and animations significantly enhance the impact of educational storytelling. They **capture attention** more effectively than text alone, ensuring children stay engaged throughout the lesson and become more **emotionally invested in the learning process** (Vistas Learning, 2024). The STEAM Tales stories feature a hand-crafted portrait of the female protagonist on the cover, complemented by **simple illustrations that depict key moments and elements** from the story.



Visuals from the STEAM Tales story about Rita Levi-Montalicini

TIPS AND TRICKS

- **Set clear goals**: Define the story's purpose (e.g., explain a concept, inspire, or explore a moment).
- **Structure the story**: Prefer a chronological approach and structure the story with a clear beginning, middle, and end.
- **Stimulate thinking and engage emotions**: Pause to ask questions and prompt reflection. Evoke emotions like curiosity or hope to enhance memory and motivation.

- **Empower**: End with an uplifting or empowering message.
- **Use follow-up activities**: Reinforce learning with hands-on experiments.
- **Age-appropriate language**: Use simple vocabulary and vivid descriptions.
- **Narrative voice**: Choose first or third person depending on emotional connection or perspective.
- **Add visuals**: Use illustrations or animations to boost engagement and retention.

2.2 Building the character

STEAM Tales share inspiring stories of real women in STEM, harnessing the power of authentic representation to foster **relatability** and encourage children, particularly girls, to explore STEM fields. This approach appears to be beneficial as young girls exposed to stories of successful female scientists are more likely to view themselves as capable of excelling in science (Buckley et al., 2021).

The women featured in STEAM Tales are **portrayed in a realistic and relatable way**, with personal details and characteristics that emphasise their positive traits. While some aspects may be **idealised**, the focus remains on their qualities that serve as worthy examples for children to follow. Their life journeys are **presented authentically**, highlighting the challenges they faced in their pursuit of success in STEM fields and how they overcame these obstacles, reinforcing the importance of **problem-solving and perseverance**. By presenting role models as **real, accessible figures instead of idealised or distant** ones, their relevance and impact are enhanced (Muir et al., 2019).

Emotional connections with characters are crucial for engagement and memory retention, which is why the biographies in STEAM Tales include moments for reflection. These moments allow children to explore the motivations, decisions, and emotions of the characters during pivotal points in their lives.

Visual from the STEAM Tales story about Samantha Cristoforetti: An emotional moment of Samantha becoming a mother.

Back on Earth

Long months of Samantha's space adventure came to an end and she had to return to Mother Earth.

Question for children:
Can you imagine how Samantha felt coming home from the space?

Maybe she would miss the view from space, but she was definitely happy to breathe fresh air and, most importantly, hug her family and her husband **Lionel**. Lionel watched her journey with interest and admiration because he shared Samantha's passion for space science. He is an aerospace engineer and also trains future astronauts.

Once back on Earth, Samantha's life didn't get boring and her career any less important. About a year after returning from space, Samantha started a new, exciting journey—one of the most important and challenging in the world. She became a **mom** to a lovely baby girl and 5 years later to a boy.

The stories are **rooted in reality**, drawing on publicly available information from biographies and interviews where possible. In cases where there is no documented emotional response to specific challenges or dilemmas, the narrative allows space for interpretation, often choosing a version that portrays the character as a moral and inspiring figure.

☆ **For example:** A young woman faced with the challenge of starting university, where she would be the only female, might reflect on her emotions, perhaps feeling scared, but ultimately overcoming her insecurities and succeeding. While we may not have direct evidence of her feelings, we invite children to imagine how they might feel in such a situation. The success she achieves, however, is grounded in biographical fact. This approach helps ensure that the role models remain inspiring while staying true to their human complexity, making them both aspirational and authentic for young readers.

TIPS AND TRICKS

- **Authentic and relatable representation**: Portray female STEM role models as relatable figures, **highlighting both their strengths and struggles**. Base stories on verified facts while allowing **space for interpretation** where necessary.
- **Emotional connection**: Include reflective moments that help children explore and understand the **role models' motivations and emotions** during key moments. Invite children to imagine how they would feel in similar challenges, fostering emotional connection.

2.3 Balancing facts and fiction

Balancing **facts and fiction** in educational storytelling is a delicate art, making the narrative both **engaging and informative**. In the STEAM Tales stories, fiction is used solely to **enhance engagement and help children connect with the role model without altering the factual content**. Small fictional elements, such as details about the main character's personality or everyday settings, are included to capture attention and make the story more relatable for children.

☆ **For example:** At the beginning of a biographical story, a reference to what the main character enjoyed doing as a child invites children to connect through shared experiences and personal interests.

Visual from the STEAM Tales story about Samantha Cristoforetti: the beginning of the story presents Samantha as a small girl with big dreams.

From mountains to space

There is a place in northern Italy surrounded by beautiful mountains and crystal-clear lakes called Val di Sole, which means Valley of the Sun. In the middle of pristine nature lived a little girl who was as sunny as the name of her home region. Her name was **Samantha.** She lived there happily with her mom, dad and brother.

Samantha was a very bright girl, an avid reader curious about the world around her. She enjoyed running on the grass and dreaming of the world beyond the skies. On summer nights, she would lie on the ground and watch the starry sky, imagining one day becoming an **astronaut** and reaching the stars.

Samantha's parents encouraged their daughter's aspirations and gave her all the freedom to dream and plan her own future. She was lucky to be living in a time and place where she could study and do practically whatever she wanted. She had plenty of opportunities within her reach and the freedom to make her own choices.

Research (Buckley et al., 2021) suggests that **realistic**, **fact-based narratives**, even if brief and simplified, help challenge stereotypes and shape beliefs. Since the STEAM Tales stories are based on the real lives of remarkable women, the core narrative must stay grounded in reality. To serve educational purposes, the stories were carefully edited and simplified, highlighting only the **key milestones** in each protagonist's life and placing particular emphasis on their careers in the STEM fields.

TIPS AND TRICKS

- **Stay true to facts**: Keep the core narrative grounded in real events, simplifying complex details but preserving key milestones.
- **Use fiction to engage and create relatable characters**: Use fictional touches, such as childhood activities, to help children connect emotionally with the character to make the story relatable and engaging without altering facts.
- **Explain complex ideas**: Personify abstract concepts through fiction to make them easier for children to understand.

2.4 Aligning storytelling with educational goals and outcomes

The structure and content of a **compelling educational story** should be guided by a clear **learning goal**, whether it's to explain a concept, explore a historical moment, or inspire. The main objective of the STEAM Tales stories is to **inspire and empower children**, particularly girls, by showcasing the achievements and contributions of women in science, technology, engineering, and mathematics. These stories aim to challenge stereotypes, promote gender equality, and encourage an interest in STEM subjects. By highlighting the journeys and successes of female role models, the stories **help develop children's self-confidence, motivate them to pursue education and careers of their dreams, and foster a deeper understanding of the diverse**

possibilities within these fields. The ultimate goal isn't, however, to persuade children to become professionals in STEM fields, but to emphasise that there are no gender, ethnic, religious, or other barriers, **presenting STEM as fascinating and accessible to everyone**. Storytelling can effectively engage and impact all **three key domains** of learning outcomes: **cognitive**, **affective**, and **behavioural**.

Cognitive learning

Cognitive learning involves acquiring and understanding **knowledge** and **information**. Storytelling enhances cognitive learning by **presenting information in a structured**, **meaningful**, and **memorable** way. It helps children make **sense** of complex concepts through relatable characters, cause-and-effect sequences, and contextualised scenarios. This narrative format aids **comprehension**, promotes **critical thinking**, and improves **retention** by linking new knowledge to existing mental frameworks.

Moreover, early storytelling fosters metaphorical and imaginative thinking: Skills like comprehension of metaphor, pattern recognition, and the use of proverbs are early cognitive competencies, not signs of irrationality (Egan, 1986).

☆ **For example:** STEAM Tales stories foster cognitive learning by combining the real-life journeys of women in STEM with the introduction of key STEM concepts. Children learn about the challenges and successes of role models and also encounter and engage with scientific ideas, principles, and discoveries in an accessible way. By contextualising STEM concepts within the personal experiences of these women, the stories help children understand complex ideas through relatable narratives, promoting better retention and deeper comprehension.

Affective learning

Affective learning relates to **emotions**, **values**, **attitudes**, and how children respond **emotionally**. Storytelling enhances affective learning by creating **emotional connections** between children and the content. Stories evoke **empathy**, spark **curiosity**, and encourage **reflection** on personal **values** and **attitudes**, helping children internalise lessons, develop a deeper understanding of diverse perspectives, and form meaningful connections with the subject matter. As a result, storytelling can shape children's beliefs, **inspire positive behaviours**, and support the **development of social and emotional skills**.

As Egan (1986) suggests, children possess a powerful emotional and poetic imagination that should be nurtured, laying affective foundations for moral and social development.

☆ **For example:** STEAM Tales stories foster affective learning by engaging children's emotions through the inspiring stories of women in STEM, challenging stereotypes, and empowering them to believe in their potential, making STEM more approachable.

Behavioural learning

Behavioural learning focuses on the development and application of **practical skills** and **actions.**

Storytelling enhances behavioural learning by **modelling actions**, demonstrating **problem-solving**, and providing scenarios where children can observe and reflect on specific skills in context. Through narratives, children see how knowledge is applied, what decisions lead to successful outcomes, and how characters navigate challenges, inspiring them to replicate or adapt these behaviours in real-life situations.

☆ **For example:** In STEAM Tales stories, this is additionally supported through story-based activities designed to encourage children to engage in simple hands-on experiments that bring the story's lessons to life. These activities help translate abstract STEM concepts into practical experiences, directly connected to the work of the featured role models. This approach not only makes the professions of the role models more tangible but also deepens children's understanding of the scientific concepts themselves.

TIPS AND TRICKS

- **Set a clear learning goal**: Define what the story aims to teach or inspire, whether it's a STEM concept, historical moment, or role model.
- **Enhance cognitive learning**: Present complex concepts through simple, relatable narratives that improve comprehension, critical thinking, and memory retention.
- **Develop social and emotional skills**: Use stories to inspire positive behaviours and foster empathy, shaping children's attitudes and values towards others.

- **Promote active learning**: Incorporate hands-on activities and experiments related to the story to bring abstract concepts to life and deepen understanding.

2.5 Forms of storytelling

Storytelling in education takes many forms, each offering **unique advantages depending on the learning context, needs and goals**. Below is a brief overview of various storytelling formats, their applications, and supporting research.

Oral storytelling: STEAM Tales stories are based on oral storytelling, where teachers (or other adults) **read aloud to children while displaying the accompanying illustrations**. The storytelling is **interactive, incorporating questions and opportunities for children to reflect**, fostering engagement and deeper understanding.

Oral storytelling is one of the oldest educational tools, engaging learners through **voice modulation, gestures, and interaction**. According to Dujmović (2006), oral storytelling enables the students to connect the story to their own lives so that they understand human behaviour. By listening to the story, we learn language skills in vocabulary and reading comprehension and to understand the universal truth of human relationships and dealing with others. It enhances **listening skills** and **memory retention** and develops **critical thinking** through dialogue and questioning (Egan, 1997).

Written storytelling: Written narratives in education range from **traditional literature** to **reflective or creative writing** and case studies.

Visual storytelling: Visual storytelling includes **comics, graphic novels, illustrations, and infographics** that convey narratives through images.

Digital storytelling: Digital storytelling combines multimedia elements – **text, audio, video, and animation** – to create interactive narratives such as digital stories (for example with eBooks, Canva or Genially), podcasts, video essays or augmented reality (AR) storytelling. McLellan (2006) defines digital storytelling as "the art and craft of exploring different media and software applications to communicate stories in new and powerful ways using digital media".

Role-playing and interactive storytelling: Role-playing and interactive narratives allow students to **step into a character's perspective and actively participate in a story**.

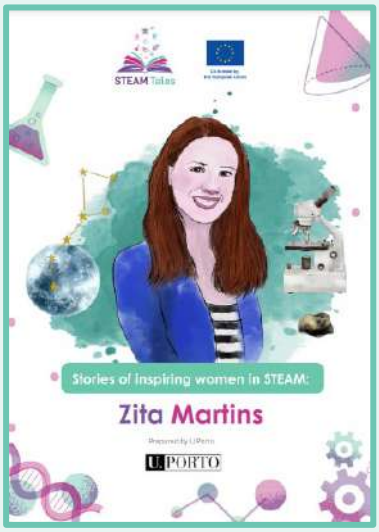
Each storytelling format offers unique strengths in education. **Oral storytelling** builds listening skills, **written storytelling** enhances literacy, **visual storytelling** aids comprehension, **digital storytelling** fosters multimedia literacy, and **role-playing** supports experiential learning. Combining these methods can create rich, engaging learning experiences tailored to different educational goals.

Chapter 3: Strategies for implementing storytelling in the classroom

3.1 The impact of using narratives

Narratives provide context. By using them in storytelling, abstract STEAM concepts become more understandable and accessible. Using a well-designed story can **illustrate the real-world impact of science** which helps children think and **see themselves as potential problem-solvers**.

☆ **For example:** Two examples of stories created under the STEAM Tales projects are:



- Our story about Zita Martins, an astrobiologist who dreamed of studying life in the Universe, can inspire children by showing how she overcame obstacles and introduced astrobiology in Portugal. Despite facing challenges, she left her home country to pursue her passion, becoming the first Portuguese scientist in this field, which shows that perseverance can lead to amazing discoveries.

- Our story about Emmy Noether, a mathematician who defied gender barriers in academia, can show children how determination and resilience can break societal norms. Denied formal education at first, Emmy persisted, and revolutionised mathematics and physics with her theories by proving that passion and hard work can overcome discrimination.

Children engage more deeply with stories when they **see themselves from the point of view of the characters**, which activates brain areas linked to real-life memories and enhances learning. Similarly, highlighting relatable struggles, such as a scientist overcoming early academic challenges, not only reshapes perceptions of who can succeed, but also helps children believe that they, too, can succeed through perseverance and effort.

Thus, by integrating narratives into STEAM education, teachers not only make complex concepts more relatable but also **inspire children to see themselves as future scientists, innovators, and problem-solvers**.

3.2 Interactive and multimodal storytelling approaches

Effective storytelling in the classroom **engages multiple senses and invites active child participation**. Research shows that **combining oral narration, visuals, movement, and interactive dialogue strengthens retention, motivation, and critical thinking in STEAM subjects**. Below are strategies to make classroom storytelling immersive and impactful:

- **Call-and-response interaction**: Storytelling should be participatory. It should **allow children to predict outcomes, act out scenes, or contribute** to the narrative. By posing questions like "What do you think will happen next?", critical thinking is encouraged, and comprehension and retention are boosted.
- **Voice and expression**: Using **tone, pace, and gestures** makes storytelling more dynamic. **Varying voices for characters, pausing for emphasis, and conveying emotion** help children connect with the narrative. Studies reveal that expressive narration improves recall and vocabulary retention over monotone delivery.

TIPS AND TRICKS

- Before telling a story to children, **practice** using different tones and pacing.
- Try **recording yourself** and playing it back to assess what can be improved or adapted.
- Ask yourself: **Where can I pause? What emotion should I show and when?**

- **Using visuals and props**: Seeing a story unfold enhances comprehension. Incorporating **illustrations, props, or gestures** anchors abstract concepts in reality, making them easier to grasp.

☆ **For example:** Teachers might use star charts for an astronomy story or simple lab materials when discussing a chemist's experiments.

- **Storytelling through assigned roles**: Assigning children different character roles in a story keeps them engaged while improving fluency and confidence. **Reading in turns** allows hesitant readers to participate without pressure. Beyond role-play, children can also **retell familiar stories or create their own, building public speaking skills and narrative structure**. Classrooms where children take on storytelling roles show higher engagement and motivation.

TIPS AND TRICKS

Prepare simple cards with a character's name and one trait: Children draw a card and speak or act as that character during the story. It's a quick way to boost engagement and imagination, especially for shy children.

- **Co-creating stories with children**: Encouraging children to contribute to a story's development increases engagement and creativity. Teachers can ask for their ideas in terms of **filling in missing details or choosing plot directions** as the story develops collaboratively. This approach, where children take turns adding to a story, encourages even reluctant speakers and writers to join in.
- **Digital tools**: Even though live, expressive storytelling remains the most effective way to spark imagination, digital tools can offer **additional support for diverse learners**. Short video clips or digital storyboards can **add context or visual flair**. Educators can smoothly blend in technology, e.g., brief animations or slides, but should **prioritise interactive, in-person narration** to maintain a personal connection.

By uniting interactive techniques with multimodal elements, storytelling transforms from a simple read-aloud into a dynamic learning experience, deepening curiosity, empathy, and understanding in STEAM education.

3.3 Adapting stories to diverse learning styles and classroom settings

Every classroom is different. Teachers work with children who have a wide range of **cognitive strengths, language abilities, and learning preferences**. To ensure storytelling is effective for all learners, it must be adapted in both **delivery and structure**.

Children process stories in different ways: some respond better to **spoken words, others to visual aids, gestures, movement, or hands-on activities**. A flexible approach allows teachers to meet these varied needs. For example, combining **oral**

narration with illustrations or physical objects can **make abstract STEAM concepts more concrete**.

For children with **language or speech challenges, simplified language, repetition, and visual aids** support comprehension. This also applies to English language learners (ELLs), who benefit from **predictable story structures, visual supports**, and, when possible, **bilingual storytelling that connects to their home language**. Non-verbal methods like **drawing or role-playing** help reinforce understanding across all learner types.

Cultural inclusivity is also essential. Children connect more when stories reflect diverse backgrounds and relatable characters. **Incorporating folk tales, myths, and real-world narratives** fosters appreciation of different perspectives. Hence, teachers should **contextualise cultural references** and provide necessary context.

Read more about how to ensure inclusivity and diversity in Chapter 1.2.

In terms of classroom settings, storytelling can be enhanced by simple routines, such as **using music to signal story time**, or by **creating a dedicated storytelling space** to help children focus. Pair or group discussions allow students to reflect on the story and connect it to their experiences. **Outdoor storytelling** (for instance, conducting a nature-related story in a garden) can make stories **more immersive and memorable**.

Finally, adapting story length, pacing, tone, and interaction level is essential when working with mixed-ability or multilingual groups. This flexibility ensures

all children are engaged and able to benefit from the learning experience, regardless of their background or abilities.

By adjusting **how stories are told**, rather than just on who or what they're about, teachers create a **more inclusive, responsive**, and **effective learning environment.**

3.4 Storytelling with hands-on activities

Storytelling that connects narrative and hands-on learning improves both retention and problem-solving skills. When teachers **frame lessons with a story and then conduct a related hands-on experiment**, children become emotionally invested and motivated to **understand and apply the subject principles** the story relates to.

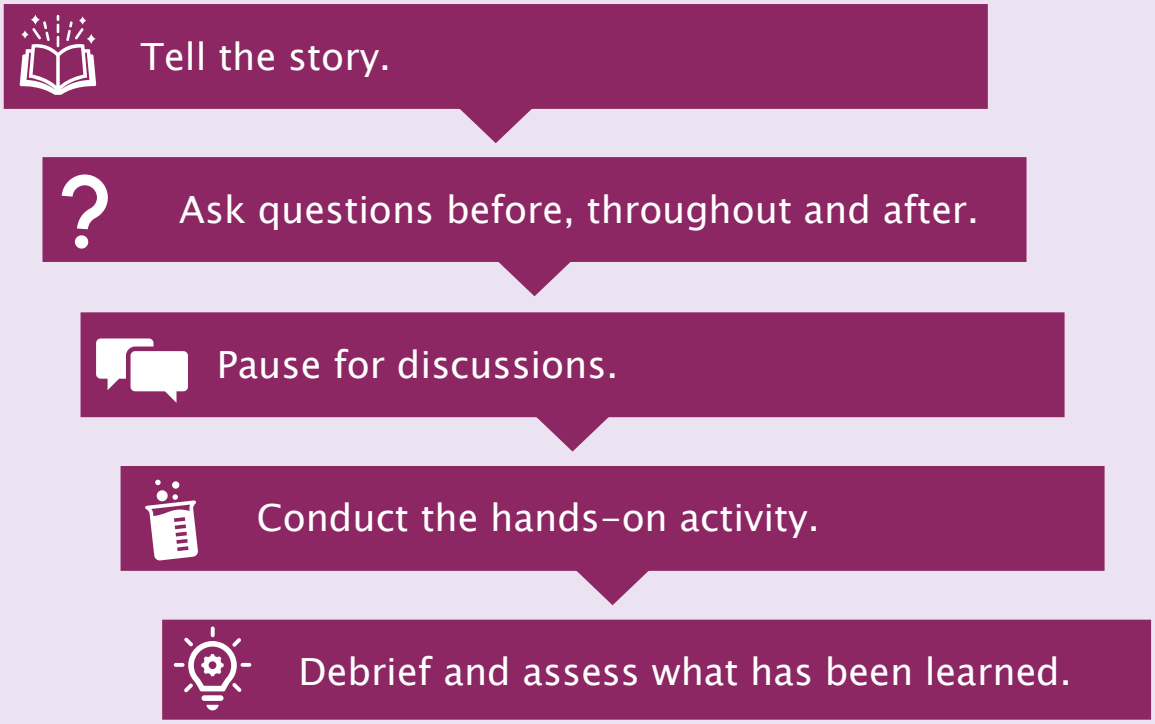
Read more about specific examples of how STEAM Tales integrates storytelling and experimentation in Chapter 5.6 and Chapter 5.7. This section shares general guidance for combining story with classroom practice.

☆ **For example:** STEAM Tales pairs stories about female scientists with classroom activities, such as building paper rockets after reading about an aerospace engineer.

Instead of teaching concepts in isolation, teachers can **blend them into a storytelling session**. A botanist's narrative might illustrate the scientific method, while an engineer's journey introduces design thinking. Research shows that this **pre-instruction storytelling strengthens recall and knowledge transfer**. Children learn ideas more organically by observing how characters use these principles to solve real challenges.

TIPS AND TRICKS

Begin your lesson with the story, not the hands-on activity. Let the story introduce the challenge, then invite children to solve it with an experiment. This framing **enhances curiosity and retention and gives meaning** to the activity through a real-world connection.



By merging storytelling with hands-on tasks, children view STEAM not merely as theoretical content, but as a **creative, problem-solving field**. This approach fosters sustained engagement, resilience, and curiosity, which helps children **connect knowledge to the real world** and **see themselves as active participants in discovery and innovation**.

For more information about the combination of storytelling and hands-on activities, see Chapter 4.4.

3.5 Success stories and best practices

Research has also shown that children retained complex concepts better when learned through narratives, **recalling details about scientific processes by referencing story characters**. However, narratives alone may not fully change children's gender perceptions in STEAM fields, as shown in a pilot-testing conducted in Portugal in June 2024. Children often associate maths only with school and teachers or don't have a clear idea of what engineering entails. This suggests that further **activities and discussions beyond storytelling** are needed to address STEAM awareness and gender role biases.

TIPS AND TRICKS

- **Start with clear objectives** and choose stories that align with lesson goals.
- **Use expressive, interactive delivery** as tone, gestures, and child input keep children engaged.
- **Allow time for an interval between the storytelling and the hands-on activity**. By doing so, children are encouraged to process the narrative, ask questions, and make connections before transitioning into the hands-on task.
- **Promote discussion on gender representation** by highlighting real-world female role models but also clarifying misconceptions about fields like engineering.
- **Reflect and adapt by gathering feedback**, noting what works best, and **iterating**. Even brief surveys can reveal whether children's perceptions about who can do STEAM are shifting.
- **Bring in additional props or materials**, when possible, to help children better visualise or engage with the hands-on activity and reinforce key concepts from the story.

☆ **For example:** To animate a story about astronomy and the exploration of space, such as Samantha Cristoforetti's story, teachers in Germany used an LED projector to display stars and constellations on the classroom ceiling. Students were thus mesmerised and even more engaged in the activity through the atmosphere.

By **combining thoughtful and immersive storytelling with hands-on projects** and explicit **discussions around gender** and careers, teachers can foster **inclusive, curiosity-driven learning environments**.

Chapter 4: Assessment and reflection through storytelling

4.1 Evaluating perceptions and interest: insights and recommendations for learning outcomes

Several studies show that **children's perceptions of male and female abilities and gender roles are conditioned from the cradle by society,** which consolidates these stereotypes in gender-biased situations.

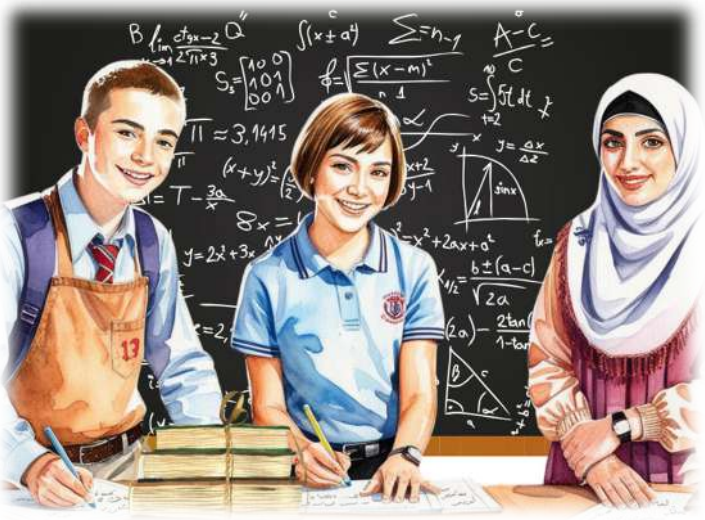
To this day, a long-standing stereotype persists that associates the male gender with the basic logical and mathematical skills of Science, Technology and Engineering and, ultimately, with professional representation in this field. **The dissemination of stereotypes starts in the family environment** when a child is born and starts being associated with different colours, toys and games according to their gender. However, this prejudice is felt not only in the family environment, but also in the classroom, where **teachers might externalise it both consciously and unconsciously** through the support and encouragement they give students according to their gender and the remarks they make.

☆ **For example:** In Maryam Mirzakhani's story, Maryam, whose fascination with maths was partly fuelled by her brother, struggled in a society conditioned by stereotypes about what girls were or were not supposed to study and work with. Maths was not seen as a subject that suited women.

Girls' confidence in their STEAM-related abilities – such as the 4Cs: **critical thinking, creativity, collaboration and communication**, related by the 2030 Agenda as transversal skills that are essential for the future – begins to decline between the ages of 6 and 8, a period coinciding with the first years of school education.

Moreover, the combination of the prevalence of stereotypes in STEAM field and the lack of confidence in STEAM-abilities can lead girls to feel disinterested in STEAM fields or even to feel the urge to withdraw from them even if they are interested in the field, for **fear of being judged negatively** for engaging in this professional field and of **reinforcing negative views about their gender if they perform poorly**. This is the basis of the concept of stereotype threat: when the mere **possibility of being discriminated against because of stereotypes** about the group to which one belongs is a source of ongoing stress.

And thus, a vicious cycle of disinterest, demotivation and stereotyping is fed. The talent, interest and initiative of many girls in STEAM are repressed and end up not being capitalised on – a situation that **contributes to female underrepresentation in the fields and reinforces systemic inequalities in these fields**. The path to equity, therefore, involves breaking down stereotypes that will enable many girls to **develop a positive STEAM identity**. The notion of STEAM identity encompasses how individuals view science, technology, engineering and maths and how they perceive their aptitudes for these disciplines. A positive STEAM identity should start with **early exposure to STEAM subjects**, as these are crucial in building the foundation of girls' skills and interests, and can be fostered by **providing encouraging role models, participating in science activities and engaging in STEM experiences**.



Considering the above, the outcomes that the STEAM Tales project has defined for the application of its stories and lesson plans in the school context revolve in a substantial way around the internalisation of the **equity of girls' and boys' abilities in STEAM fields**, with a particular focus on encouraging girls to identify with female role models in these areas.

TIPS AND TRICKS

- **Look for stereotype-defying role models**: When introducing children to STEAM, try to diversify your group of role models - look for women, non-Caucasian, or people with disabilities, for example.
- **Present the role models in a respectful and empowering tone**: Introduce the role model by highlighting their skills, the obstacles they have overcome, and their path to success in their professional careers in STEAM fields to create a proximity and familiarity between the model and the children.

4.2 Encouraging the promotion of psychological processes in children through the lens of storytelling

The Hero's Journey is not simply a narrative device used in fiction - whether it's mythology, literature or film. It **reflects reality as a metaphor for the transformations of consciousness** we all go through in life. The great narratives that mark our lives and cultures, that arouse our emotions and from which we draw pleasure and wisdom, generally boil down not only to the overcoming of a challenge but also to the learning and character-building that go with it, and they can serve as inspirational metaphors for our own lives.

Learn more about the Hero's Journey storytelling model used in STEAM Tales stories in Chapter 1.3.

The **process of identification with the protagonist** gains relevance: the exploration of the models' stories, based on their biographies, leads girls to identify with them. The female role models are revealed to be **human beings like any other, endowed with limitations and forced by life to face very relatable challenges**. This can strengthen girls' confidence in the face of a lack of community support, stereotyping or any other sort of hardship. Exposure to these narratives can also be beneficial to boys: when confronted with the prejudice and injustice the heroin had to face, they might **question their own biases** in a process of decentration through self-reflection. This leads to the concept of **metacognition – the ability to think about our own thoughts and evaluate them critically**, preventing them from automatically conditioning our behaviour and attitudes.

☆ **For example:** In Asta Hampe's story, as a German woman working in engineering in the early and middle 20th century, Asta had to face a lack of support from her father and community, but she overcame all that and managed to become a recognised engineer, teacher and politician. Stories like this, which deal with overcoming difficulties, can encourage children in times of difficulty and also open their eyes to prejudice, both in the surrounding society and in themselves.

TIPS AND TRICKS

- **Explore diversity:** Feature relatable characters from varied genders, ethnicities, cultures, religions, abilities, and personality types, ensuring all children feel represented in the story through identification and develop empathy for others.
- **Encourage (self-)reflection and metacognition:** Encourage the children to reflect on the adversities the character had to go through to succeed (including the prejudice and discrimination she was subjected to) as a way of boosting their confidence in the face of life's challenges and getting them to recognise and deconstruct biases and prejudices they themselves may have. For instance:
  - ✓ What do you think she felt?
  - ✓ What would you do if you were in her place?
  - ✓ Do you think it was fair that she was not allowed to do this?
  - ✓ What can we learn from this?

  Example: A "Question for children" section from Elvira Fortunato's story.

Question for children:

Do you think it's fair to be judged by others just because of who you know or work with? How would you feel if people only considered you because of someone else's presence or influence on your actions or accomplishments? How would you show people your own talents?

- **Finish with uplifting messages:** Never forget to emphasise that it is within everyone's power – regardless of their origins, ethnicity, gender or physical condition – to overcome difficulties and make their dreams come true.

4.3 Assessment of students and the application of storytelling

Given the importance of promoting new methodologies at school that can help children (and especially girls) consolidate a positive STEAM identity, it is beneficial to **analyse the different types of assessments** used in the school environment in order to understand how to implement these methodological initiatives.

Diagnostic, formative, and summative assessments – **differentiated by timing, purpose and feedback usage** – serve different roles in education:

- Diagnostic assessment occurs before instruction to **gauge students' prior knowledge, skills, and learning gaps**, helping teachers tailor lessons (e.g., pre-tests, surveys, and concept maps);
- Formative assessment takes place during learning to **monitor progress and provide feedback for improvement** (e.g., quizzes, classroom discussions, and peer reviews);

- Summative assessment, conducted after instruction, **evaluates overall learning and achievement** through final exams, standardised tests, and projects – unlike diagnostic and formative assessments, which guide learning, summative assessments measure mastery of content.

Although the summative assessment has been the assessment method par excellence in schools for many years, it only offers a **snapshot of the students' theoretical knowledge**, leaving their skills, creativity and long-term adaptability unassessed. In recent years, there has been a call for an investment in formative assessment methods. These promote adaptability through continuous feedback, which even aligns with the **trial-and-error and discussion** approach that is so fundamental in STEAM fields.

Formative assessment, with its emphasis on continuous and exploratory activities, lends itself to **incorporating innovative pedagogical strategies** (such as storytelling) more easily than other types of assessment. The integration of storytelling within the context of formative assessment offers a **unique opportunity for continuous learning and reflection**.

By using a narrative structure, educators can evaluate not only students' theoretical understanding but also their **ability to apply knowledge, think critically, and engage creatively with STEAM concepts**. As students interact with the story, teachers can gain insights into their **cognitive and emotional responses to key challenges**, ensuring that feedback is relevant and timely. Storytelling, in this regard, allows for more personalised assessment, adapting to the needs of each student and fostering a deeper connection with the material.

TIPS AND TRICKS

- **Question the children throughout the storytelling:** Involve the children in the story in an interactive way, listening to their opinions on different milestones of the story and exploring their point of view throughout the narrative. These stories are written in an **interactive structure** based on the Hero's Journey Model and its psychological impacts.
- **Adapt to the children's feedback:** As the story unfolds, try to pay attention to and explore the information that the children bring to the story.
- **Use visual aids or interactive elements:** Depending on your classroom setup, using visual elements such as diagrams, drawings, or even short videos can help **bring the storytelling to life**. Students can be asked to create their own visual representations of the story or draw connections between the narrative and real-life scenarios or practical applications. These visuals can serve as a

form of formative assessment, showing how well students are making connections or understanding explanations.

For instance, STEAM Tales lesson plans come with videos depicting the experiments. An example taken from the **lesson plan "Making slime"** (based on Ana Mayer Kansky's work).

Source	In this video you can follow a similar process but with slightly different ingredients: "HOW TO MAKE SLIME For Beginners! NO FAIL Easy DIY Slime Recipe!" by Gillian Bower Slime

- **Regular check-ins:** Throughout the storytelling process, ask students to periodically **reflect on what they've learned** and **how they relate** to the hero or heroine of the story. These reflections can be recorded and submitted for ongoing assessment. By observing how students evolve their ideas and understanding over time, teachers can provide targeted feedback that supports continuous growth.

4.4 Assessing storytelling and hands-on activities' effect on engagement, interest, motivation, critical thinking skills and comprehension

In comparison to more traditional approaches to teaching, storytelling has been shown to **improve students' attention, engagement and understanding**. In the context of STEAM, it is particularly useful to **explain natural phenomena and illustrate scientific concepts**, providing children a guiding thread, motivating them to learn and entertaining them.

The potency of storytelling is linked to both **cognitive and affective motivational factors**. The act of listening to stories can foster improved motivation and emotional

engagement in children and their exposure to STEAM stories enables them to **recognise the pertinence of STEAM** and thereby increase their overall engagement and interest in STEAM subjects.

Hands-on activities are equally beneficial. By **promoting a practical application of knowledge in the real world**, they improve students' comprehension and retention of information and encourage critical thinking. It is generally accepted that students tend to retain much more when they actively engage with content, such as through practice or hands-on activities, compared to when they only listen passively.

The implementation of hands-on activities allows children to engage in practical activities, providing them with an **experience that aligns with the principles of STEM**.

> For classroom examples and strategies linking stories to hands-on activities, refer to Chapter 3.4.

This approach has been demonstrated to confer numerous benefits on children who engage with it; such as the **4 C's skills**, which are important for functioning in today's world: **creativity, communication, collaboration, and critical thinking**.

The integration of storytelling and experiments into STEAM represents a novel approach. This approach **merges two distinct elements: reading and hands-on activities, as complementary actions**. For instance, reading stories of inspiring women can enhance girls' interest in conducting hands-on experiments related to said women's work.

A combination of storytelling and hands-on activities is particularly effective in terms of learning: **stories can serve as a preparation for hands-on activities**, and such a concatenation helps **establish connections between theory and practice**, thus

nurturing children's **critical thinking skills, interest, engagement, motivation and comprehension** over STEAM fields and research.

TIPS AND TRICKS

- **Start with the story,** before you move on to hands-on activities.
- **Pause between the story and the activities**, so that the children can reflect on what they have heard and process the ideas and concepts they have been introduced to.
- **Let students role-play tip:** After the activities, let students act out parts of the story. This helps them connect with the content and reinforces what they've learned.
- **Carry out experiments that are related to the story,** the connection might be present in subjects and materials that the character works with or has worked with, and concepts covered in the narrative.
- **Refer back to the story and hands-on activities:** In future lessons, bring back characters or ideas from the story and the activities. This creates continuity and helps students remember the concepts better.

4.5 Comprehensive summary of the results from the assessment protocol

Throughout the STEAM Tales Project, materials were developed for primary school education, which aim to be used by teachers in their classrooms to explore STEAM with children. Specifically, 12 stories about female role models and 24 lesson plans based on their work were created to promote STEM subjects among children, particularly girls, and potentially influence their future professional aspirations.

These materials were implemented in a **series of sequential mini-pilots to improve their quality and suitability, validate them according to their design, identify flaws and improve them accordingly**. Following sequential validation, the mini-pilots led to pilots in which the application of the materials and procedure were tested in a variety of cultural, social and school contexts, involving five different countries in the partnership: Belgium, Germany, Italy, Portugal and Slovenia.

Young boys and girls across Europe tested our resources and expressed their perceptions of gender norms in STEM.

Check out the full assessment protocol, which presents the evaluation process and instruments used throughout the mini-pilots.

The first mini-pilot, held in February 2024, aimed to validate the storytelling model as adequate to develop stories about women in STEM fields for little children (Joseph Campbell's Hero's Journey model presented in chapter 1). A focus group was performed with six children (3 boys and 3 girls) at a primary school, during which an **exemplary story was read to the children, followed by an exploration of the emotions and psychological processes it evoked in them**. It was observed that the girls connected very quickly with the main character, supporting her throughout the story, showing sadness when she faced an obstacle and happiness and excitement

when she succeeded. Boys were impressed by the character but expressed doubts about her existence. Both boys and girls were surprised to discover that the character was real, which suggests that, initially, not even girls thought that what she had accomplished was real. At the end of the session, the image they retained of the scientist was that of an extraordinary person, unusually determined and courageous, who can be a man or a woman.

In June 2024, two further mini-pilots took place: one aimed to validate an instrument developed to assess **children's perceptions of gender representation and roles in society and in STEM, their interest in STEM fields and their professional ambitions and prospects** (with 12 children participating, 6 of whom had taken part in the previous mini-pilot – as a way to compare the results between those who had and those who had not previously heard a story). The other mini-pilot, in which 87 children took part, intended to validate the stories themselves and their joint application with the questionnaire. The stories went through adjustments, and so did the questionnaire, after which it was validated.

During these mini-pilots, researchers were able to identify gender stereotypes related to STEM but not significant among children who heard the story and children who didn't hear the story and had a glimpse of **how the combination of stories and hands-on activities could contribute to addressing these stereotypes**. It was also concluded that narratives (particularly when children could interact with the storyteller, asking or answering questions, sharing emotions and thoughts) could also stimulate curiosity and interest in STEM fields, promote critical thinking and processes of identification in girls and decentration in boys.

Between September and October 2024, the mini-pilot of the graphic layout of the stories was carried out through a focus group in which six children (3 girls and 3

boys) were asked to evaluate the illustrations created for a story they didn't know and to see if they were able to identify aspects and events in the story. The children showed enjoyment with the template and layout created and were able to tell a story very similar to the real one when given the opportunity to arrange the illustrations creatively. Five teachers were also asked to give feedback on the stories and illustrations. Their feedback was essentially positive with a few suggestions for improvement. After this, very small or minor adjustments to the stories' graphic layout were made.

Final mini-pilots conducted by UPorto in Portugal

In the final mini-pilots, held in February 2025, stories were read, hands-on activities from the lesson plans were carried out, and the diagnostic instrument was applied. During their implementation, researchers detected gender stereotypes regarding STEM fields among the children. When imagining scientists, technology experts, engineers or mathematicians, more children evoked masculine images than feminine ones. For instance, in the activity 2 that intended to assess the children's perceptions about reading, digital, writing, leadership, mathematical, care skills with "only boys", "boys and girls" and "only girls", the children associated digital and leadership skills more with boys, as shown in Figure 1. **The results show a very interesting pattern: care skills are perceived as girls' skills; digital and leadership as boys' skills; reading and mathematical skills as gender-neutral but with a pocket of students that still think of them as boys' skills.**

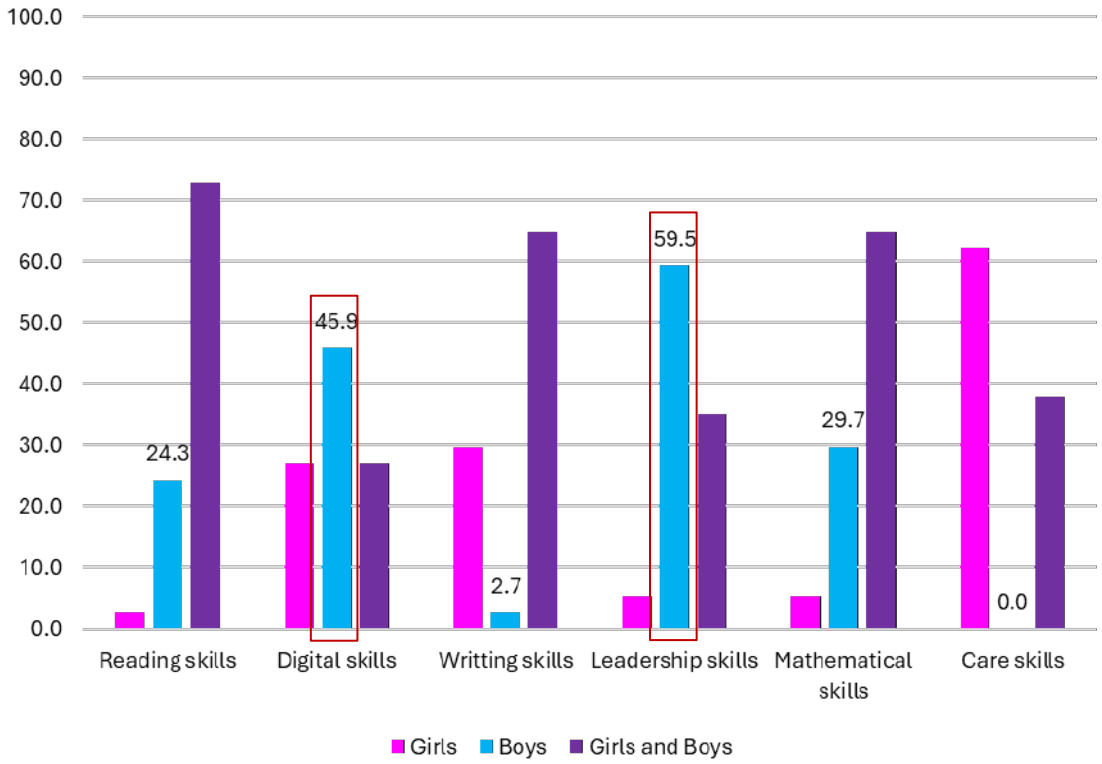


Figure 1: Association of digital and leadership skills predominantly with boys in Activity 2 of the "Instrument to Assess Children's Perceptions, Interest and Motivation in STEM Fields", diagnosed in the mini pilot of the lesson plans in February 2024.

There was also a contrast between activities 5 and 6. In activity 5, we asked the children about their interest in Science, Technology, Engineering and Mathematics. It was noted that girls were more interested in STEM subjects than boys (see Figure 2). Paradoxically, in activity 6, when asked their professional aspirations, few girls expressed an interest in working in STEM fields in the future, as presented in Figure 3. This may be related to the **lack of perceived support for pursuing a STEM career, lack of role models, and gender-based expectations** from significant others (see the questions about the significant others in the questionnaire), among others.

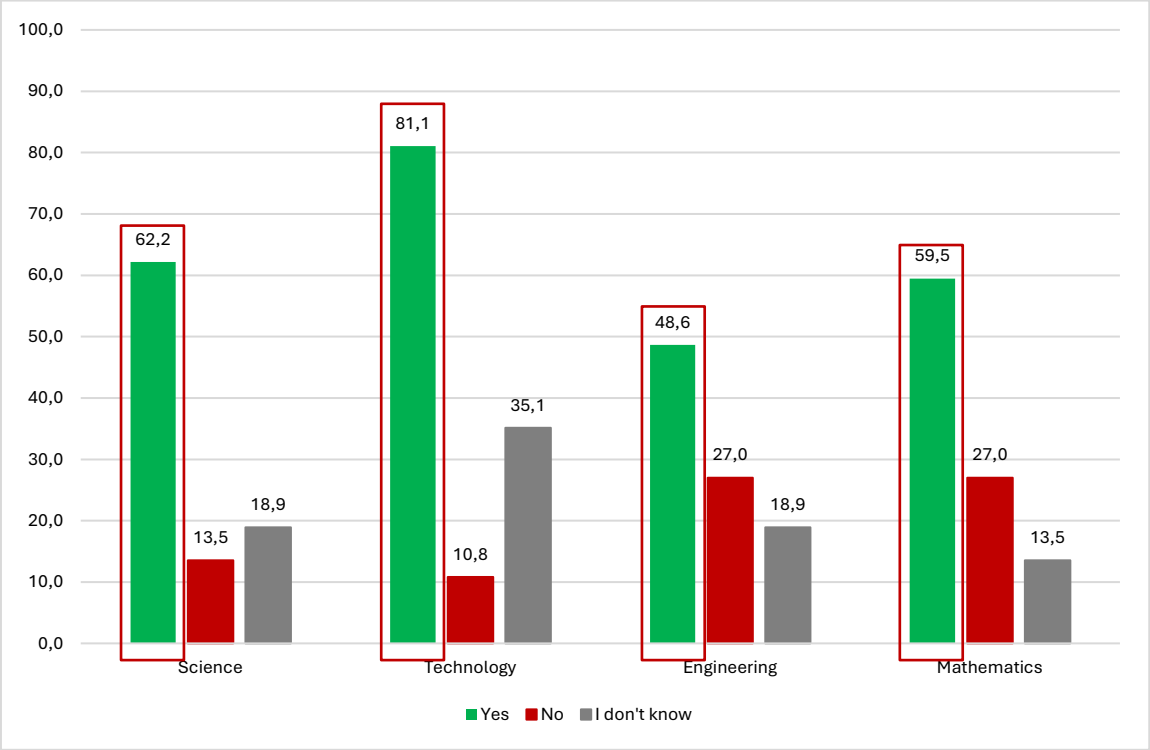


Figure 1: Girls' interest about STEM subjects in Activity 5 of the "Instrument to Assess Children's Perceptions, Interest and Motivation in STEM Fields", diagnosed in the mini pilot of the lesson plans in February 2024.

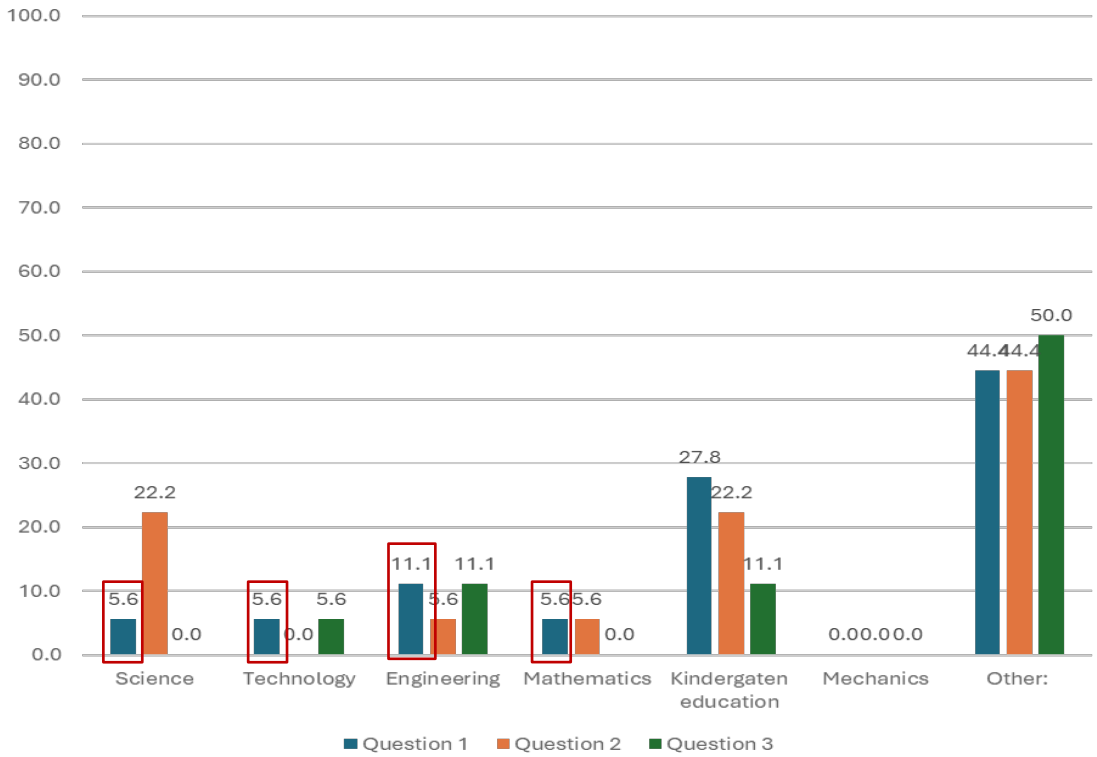


Figure 2. Children's future aspirations and ambition for a future profession in STEM fields among girls in Activity 6 of the "Instrument to Assess Children's Perceptions, Interest and Motivation in STEM Fields", diagnosed in the mini pilot of the lesson plans in February 2024.

All of these findings lend relevance to the objectives that the STEAM Tales Project sets itself, as evidenced by the positive support given by the teachers interviewed in these final mini-pilots, who praised the project for its commitment to gender equity. They also favourably assessed the lesson plans they were shown, considering the promotion of STEM fields among children to be of central importance to society. This innovative method of combining storytelling with hands-on activities can help foster children's (particularly girls') interest in STEM and also promote gender equity.

The final mini-pilots served to guide the implementation of the final pilots, carried out between April and May 2025 by all the project partners, by evaluating the intervention in schools. The detailed results of the final pilots will be available in the STEAM Tales Final Report.

Final pilots conducted by GoINNO in Slovenia

Final pilots conducted by CESIE in Italy

Final pilots conducted by Logopsycom in Belgium

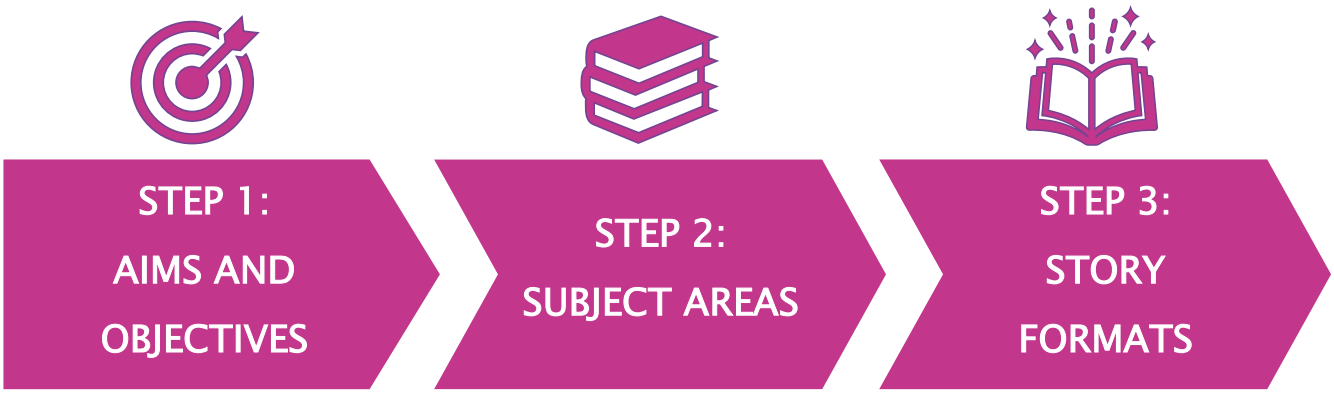
Final pilots conducted

by MIND in Germany

Chapter 5: Adapting and integrating storytelling into the curriculum and context

5.1 How to connect storytelling with curriculum standards

Storytelling is a method that can be **easily implemented across all subjects**, supporting educational goals and curriculum standards. After all, it is one of the oldest forms of teaching and, as such, a very natural way for students to gain knowledge. Here are the steps a teacher should follow when planning to include **storytelling as a teaching method**:



Step 1: Aims and objectives

A teacher should first identify the learning objectives. **What do you want children to learn through storytelling?** Is there a specific concept you want to introduce? What skills do you want them to develop? What knowledge do you want them to gain? Here are some examples for different subjects:

- Understanding the scientific process (Science)
- Practising narrative writing (Language Arts)
- Analysing historical context (History)
- Developing visual expression (Art).

☆ **For example:** You are a teacher of the 1st grade and, following the school curriculum, you should introduce geometry shapes to the classroom. Objectives are for children to be able to list at least 5 geometrical shapes, describe and draw them, and practice their critical thinking and motor skills.

Step 2: Subject areas

Which subject do you want to include? Make sure they align with the aims and objectives from step 1.

☆ **For example:** The main subject you want to cover is Mathematics, but you would also like to include the Arts and the English language.

Step 3: Story formats

When you answer these questions and know what you want children to learn (step 1) and which subject areas you wish to include (step 2), **align storytelling to your needs**. Decide on which category of storytelling you should choose to cover both steps. When it comes to the type of narrative, there are three categories of storytelling in science education (according to Hu et al.) that we will, for the purpose of this pedagogical guide, consider for all subjects. A teacher should **choose the one that is the most suitable for what they are teaching**:

- **Historical stories:** Present stories such as **biographical narratives of historical figures** (scientists, philosophers, artists, and so on) and their work to stimulate children's motivation and engagement in learning activities.

- **Imaginary stories:** Illustrate the sequence of **fictional events that directly address concepts** (scientific, philosophical, artistic or other) to promote children's understanding.
- **Personification stories:** Certain story elements are used to describe concepts (scientific, philosophical, artistic or other) by **assigning personal characteristics to the complex concepts** of a specific field, such as following the journey of a raindrop through the water cycle.

Search for stories that are already written and include content that you want to teach, or you can write your own story that you will use in the classroom.

☆ **For example:** If you search for children's books that cover geometry and are suitable for 1st graders, you could use these books (written in English):

- Shapes That Roll (by Karen Nagel)
- The Greedy Triangle (by Mailyn Burns)
- Round is a Mooncake: A Book of Shapes (by Roseanne Thong)
- Shapes in Art (by Rebecca Rissman).

5.2 Storytelling across different subjects (STEAM, language arts, history, social studies)

As we already saw, storytelling is a method that **can be easily integrated into different contexts and subjects**. The teacher's task is to find a suitable story to use that will support the aims, objectives and subjects they want to address during a lesson plan. We can now take a closer look at **what content** can be integrated into specific subjects through storytelling and examine the **unique benefits** it offers within each discipline.

Subject	Content	Benefits
STEAM	Scientific concepts, inventions, and discoveries through human stories. Biographies of scientists.	More relatable and human-centred, positive attitude towards science.
Language arts	Creating and analysing stories (oral, written, digital).	Strengthening skills of creativity, writing, communication and collaboration. Foster narrative thinking and help articulate thoughts.
History	Biographical narratives of historical figures, stories that depict a certain historical period.	Because of the personal identification, the gained knowledge is deeper and stronger (also better retention).
Social studies	Connecting different facts and contexts. A mixture of history, cultures and communities can be addressed.	Understanding the societal impact of certain events, historical figures, inventions, behaviour and theories.

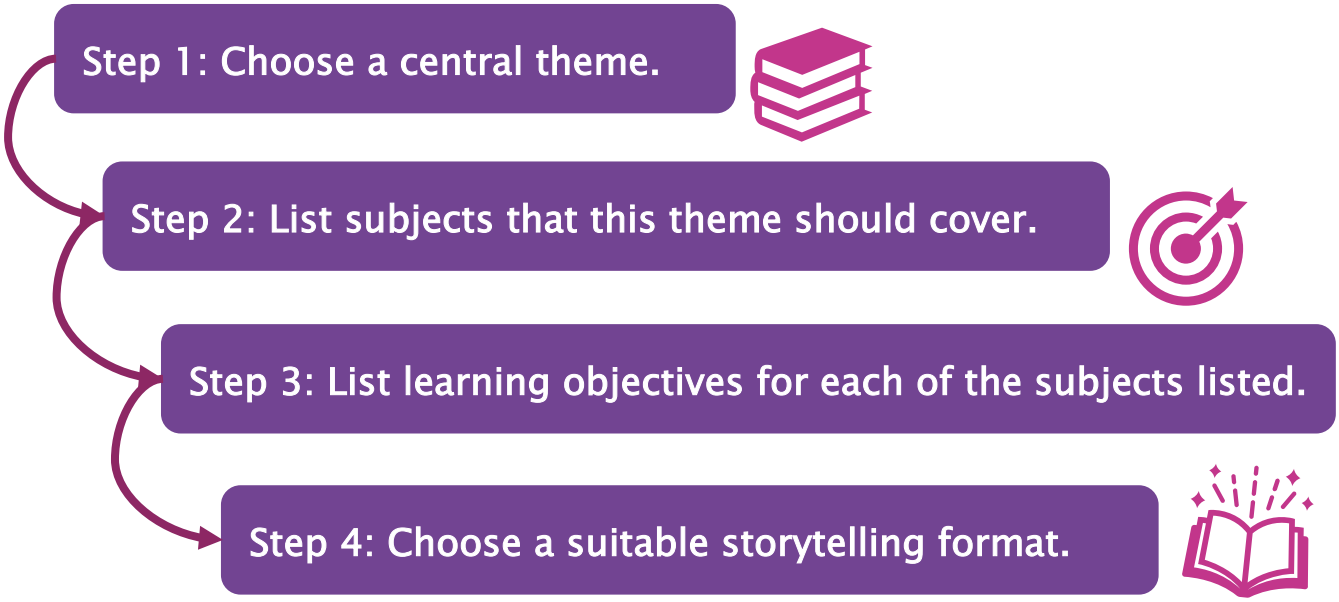
Benefits listed in the table are specific to each subject, but as we have mentioned many times before, storytelling also has many common benefits: it **provokes emotion, directs attention and stimulates understanding**, to name a few.

Integrating specific content into a subject through storytelling can be achieved by **selecting the appropriate type of narrative**: historical stories to highlight significant figures, and imaginary or personification stories to illustrate abstract concepts.

5.3 Building cross-disciplinary storytelling projects

Building cross-disciplinary storytelling projects involves blending **content, skills, and goals** from multiple subjects into a **unified learning experience**. Unlike traditional curricula which tend to separate subjects in silos, this approach highlights the interconnections between various fields of knowledge and subjects.

Adapted from the previously recommended procedure, here are the steps a teacher can follow when wanting to **start a cross-disciplinary storytelling project**:



☆ **For example:** We can take a closer look at the already mentioned example of geometry for first graders. Children listen to one of the stories (e.g. "Shapes That Roll" or Maryam Mirzakhani's story) and are introduced to the world of geometrical shapes in a fun and engaging way, because shapes in the story are personified (they have human-like characteristics). After the story is over, children are instructed to design shapes that they were introduced to with Play-Doh. After that, they are instructed to act out the story with the help of the shapes they made.

Step 1: Theme	Introduction to geometry.
Step 2: Subjects	Mathematics (geometry), English language (listening, acting out), Arts (designing shapes), Social studies (learning about people's characteristics, more precisely, that everybody has strengths and weaknesses)
Step 3: Objectives	List at least 5 geometrical shapes, to be able to describe and make them, to practice motor skills, to learn about differences between people, and to be able to articulate thoughts.
Step 4: Storytelling format	Personification story + act out (role play)

5.4 Storytelling in informal and extracurricular settings

So far, we have learned how to align storytelling with curriculum standards for one subject, how to integrate this method across different subjects and how to use it as a method for a more rounded and holistic approach to teaching. But **the classroom is not the only place where children can benefit from storytelling** in connection with the curriculum.

Change from the typical school classroom environment to a more relaxed one, where there is **no pressure related to grades**, where children are encouraged to be **more active and creative**, and where activities are introduced without the pressure to meet strict curriculum standards, is very

important. As such, informal settings offer a great complement to formal learning. These types of learning can **ignite curiosity and deepen engagement**, which formal curricula alone sometimes fail to do.

☆ **For example:** Here are some of the places that teachers or parents can search for informal settings:

- Afterschool programs
- Museums
- Extracurricular clubs
- Libraries
- Holiday workshops
- Exhibitions

If the offer for these kinds of activities is too small or even non-existent in your area, one can find content via **online resources to supplement traditional classroom learning**.

The resources of the STEAM Tales project are available on the project website and offer a great selection of activities (stories and lesson plans) to implement in the classroom, at home or in extracurricular settings.

5.5 Storytelling in inclusive classrooms (differentiation and accessibility)

So far, we have seen that storytelling is **a very pragmatic and flexible method** when it comes to its ability to adapt to different school subjects and objectives. In this subchapter, we will see that this characteristic of storytelling also applies to inclusivity.

When approached with attention to **differentiation** and **accessibility**, storytelling becomes an inclusive tool that supports learners across a wide range of abilities and backgrounds.

Stories can **reflect different cultures and life experiences**, and when selected carefully for a specific audience, can have a great impact on that group of students because students can more easily **identify with the content of the story**.

If we take a closer look at how we adapted storytelling in the case of writing biographical stories of women in the STEAM Tales project to appeal especially to girls from ages 6 to 9, the following points are worth mentioning:

- Only stories of **successful women** in the STEAM field were selected to ensure a point of identification for girls.
- Role models come from **different backgrounds, religions, cultures and nationalities**.
- In the first part of each story, features were introduced to **stimulate personal identification** for girls who are listening to the story (e.g, a general description of a role model as a little girl; what she enjoyed doing like dancing, exploring, playing in her childhood, colour of her eyes or hair and mentions of family members).

- In each story, a **positive male character** was introduced to ensure a point of identification, also for boys who are listening to the story.
- Complex scientific concepts and historical events were **simplified** to reach the target audience.
- Signs of privileged status were replaced with more **identifiable activities** (e.g. ballet was replaced with dance in the story of Zita Martins.

You can further explore how storytelling promotes inclusion and gender representation in Chapter 1.2, which outlines the design choices behind character diversity in the STEAM Tales project.

Stories are not adaptable only when it comes to the content, but also when it comes to the method of implementation. Stories can **be read, listened to, watched or interacted with.** This means that storytelling is a more than suitable method for students with visual or hearing impairment, and the same goes for students with cognitive and learning disabilities.

One way of adapting storytelling to the specific learning needs of students is taking advantage of emerging technologies in education, one of those being **digital storytelling.**

Digital stories enable students to explore scientific concepts creatively while **enhancing problem-solving and communication skills**. They allow students to explore complex topics in a more relatable, creative format.

Read more about this in Chapter 2.

5.6 Examples from STEAM stories and lesson plans

The STEAM Tales project aims to encourage young learners, especially girls, **to develop an interest in STEAM subjects**, and because there are too few known female role models in the STEAM area, we decided to change that. Because we wanted to present female role models through stories, their achievements, their struggles, and their life story, we chose **biographical narratives of historical figures** that fall under **historical stories** (out of three categories, the other two being imaginary stories and

personification stories, which are more suitable for presenting concepts) as the most suitable for our goal.

After we wrote 12 biographical stories, one for each role model that we chose, we searched for two hands-on experiments suitable for children from ages 6 to 9 that were connected to the STEM area each female scientist was or still is active in.

In the first part of each lesson plan, we listed **learning objectives** that we wanted children to learn from each experiment. Sometimes, it was a **concept** (e.g. friction, solvents, electrons), sometimes a **skill** (fine motor skills, critical thinking, communication) and sometimes specific **knowledge** (identify at least two objects that respond to static electricity, what is atmosphere, identify some of the laboratory equipment).

☆ **For example:** From the lesson plan connected to the role model **Asta Hampe, Building an electromagnet**:

Learning objectives	At the end of this experiment, children will be able to: • Construct an electromagnet using copper wire, an iron nail, and a battery. • Explain how electric current creates a magnetic field. • Demonstrate the difference in magnetic strength based on the number of wire loops. • Provide examples of how electromagnets are used in real-world devices (such as motors and cranes).

The next thing was **listing subjects from the STEAM area** that the specific experiment is connected to. For instance, with the lesson plan **The World Wide Web game** (connected to **Rose Dieng-Kuntz's story**), we listed Technology, Art and Maths. Because STEAM is by definition an approach based on the integration of other disciplines, the STEAM Tales project became a **cross-disciplinary project** very naturally. With a combination of storytelling and STEAM hands-on experiments supported with the whole lesson plan scenarios, it offers a **unified learning experience that interconnects different knowledge and subjects**, from mathematical concepts to art (e.g. **Flexible geometry** in the lesson plan connected to Maryam Mirzakhami) and from scientific concepts to engineering (e.g. **Cleaning an Oil Spill** in the lesson plan connected to Ángela Piskernik) with knowledge and skills connected to language, as every story and lesson is translated in all the partnership languages (English, French, German, Italian, Portuguese and Slovenian).

☆ **For example:** From the lesson plan connected to the role model **Asta Hampe, Building an electromagnet**:

Related STEAM areas:

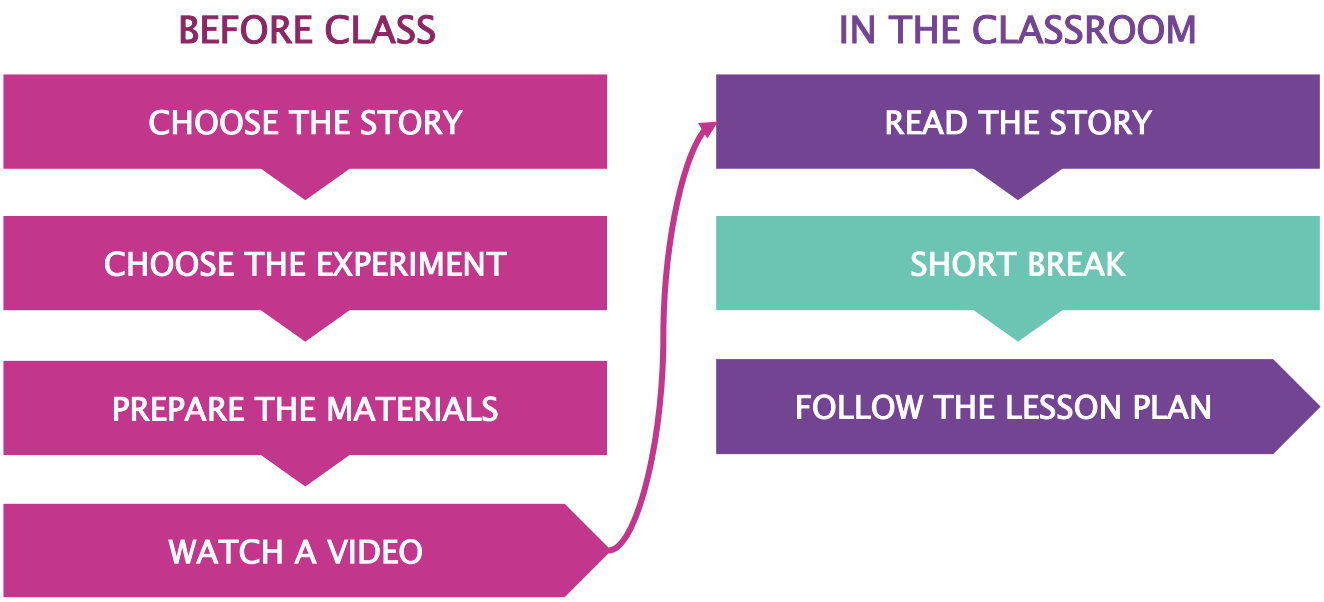
S (Science): Exploring the relationship between electricity and magnetism, and understanding how an electric current generates a magnetic field.

E (Engineering): Constructing a functional electromagnet and analysing how design choices, like the number of wire loops, impact its strength.

M (Maths): Counting and comparing the number of wire loops to observe how increasing the coils affects the electromagnet's strength.

5.7 Examples of how to use STEAM stories and lesson plans/experiments

If you are a teacher of 6 to 9-year-old children and want to use materials that were developed in the STEAM Tales project, here is how to use them:



Before class

- First, **choose a story or a lesson plan that aligns with the theme, area or subject** you want to cover in the classroom.
- **Choose one experiment** (or both) that you want children to perform.
- **Prepare all the needed materials.**
- **Watch a video of the same or a similar experiment** that is listed in the "Source" section of each lesson plan to make sure you can replicate each step adequately.

In the classroom

Part 1: The story

- **Read the story** out loud to the classroom.
- **Use the tips and tricks** listed in this pedagogical guide to make it more engaging and interesting.

- **Mind signs for questions** (make sure to give children enough time to answer them) and explanations.
- Reading one story, including interaction with children, should take **approximately 45 minutes**.
- After reading the story and before starting the experiment, you can **take a short break** to help children regain focus.

Part 2: The lesson plan

- **Start the lesson plan with a question** for children (you can find one in each "Introduction") to engage them and make the connection between the content of the experiment with something familiar to them.
- Let the children know how the experiment they are about to perform **connects to the role model from the story**.
- **Ask them a research question or hypothesis** to help children reflect on the topic before exploring it and let each child give their answer.

- **Follow the step-by-step instructions** of the experiment with the help of the videos and resources to guide you if need be.
- After the experiment, **check the research question** with the group.
- **Explain the experiment in a child-friendly way** (using the "Explain the experiment" section).
- If children want to know more about the experiment, you can help yourself with "The science behind" section.

Conclusion

Storytelling is a powerful and adaptable pedagogical tool that supports **inclusive, accessible, and meaningful learning across various subjects and learning environments**. When thoughtfully designed and delivered, it fosters **emotional development, engagement, empathy, and cognitive understanding**, especially in STEAM education, where abstract concepts often require a more concrete and relatable approach. Through oral or written narratives, visual or digital formats, role-playing, active participation and hands-on application, **storytelling can transform classrooms into dynamic spaces of discovery and connection**.

By grounding stories in real-life role models and aligning them with clear curriculum goals, educators can create learning experiences that are both **emotionally resonant, personally empowering, creatively inspiring and educationally impactful**. The use of diverse characters and inclusive formats ensures that every pupil, regardless of background, ability or gender, **feels seen, valued, and capable of succeeding**. Highlighting female role models through storytelling has proven effective in **combating stereotypes and encouraging girls' participation in STEAM fields**.

When combined with hands-on activities and formative assessment, storytelling becomes a particularly promising strategy for motivating all learners and promoting key soft skills such as **creativity, self-reflection, emotional awareness, critical thinking and problem-solving**, which are essential in one's daily and professional life.

Ultimately, storytelling offers a holistic and well-rounded approach to learning, **easily adaptable, naturally immersive and well-suited for all forms of education**. Once you select a theme, identify the objectives and subjects to cover, and select the right content and formats, the possibilities are endless!

By exploring our STEAM Tales resources, specifically the 12 women's stories and 24 corresponding lesson plans, and by applying the tips, examples, best practices and strategies provided throughout this guide, teachers can craft and implement stories that **support emotional growth, motivation, key skills and curriculum goals, making STEAM education more dynamic, inclusive, inspiring and empowering for all learners.**

Bibliography & further readings

Chapter 1: The power of storytelling in inclusive education

- Amirinejad, M., & Rahimi, M. (2023). *Integrating Digital Storytelling into STEAM Teaching: Examining Young Language Learners' Development of Self-regulation and English Literacy.* International Journal of Technology in Education, 6(4), 720-735. https://ijte.net/index.php/ijte/article/view/1461
- Atreya, A. (2024). *Storytelling – a powerful cognitive tool in the early years.* Exchange Press. https://hub.exchangepress.com/eed/storytelling-a-powerful-cognitive-tool-in-the-early-years/
- Buckley, C., Farrell, L., & Tyndall, I. (2021). Brief stories of successful female role models in science help counter gender stereotypes regarding intellectual ability among young girls: A pilot study. *Early Education and Development, 33*(1). https://doi.org/10.1080/10409289.2021.1928444
- Caldwell, K. (2012). *Storytelling as a Pedagogical Tool.* Teaching Through The Arts. https://teachingthroughthearts.blogspot.com/2012/07/storytelling-as-pedagogical-tool.html
- Chugh, C. (2024). *The role of storytelling in Child Development Psychology.* https://drchandrilchugh.com/blog/role-of-storytelling-in-child-development-psychology/
- Collins, S. N. (2021). The importance of storytelling in chemical education. *Nature Chemistry, 13*(1), 1-2. https://doi.org/10.1038/s41557-020-00617-7
- Conley, S. (2024). *Uncovering the Hero's Journey: Joseph Campbell's guide to Resilience, Transformation, and Self-Discovery*. Academy of Life Planning. https://academyoflifeplanning.blog/2024/10/30/the-heros-journey/
- ECD Training. (2023). *The benefits of storytelling in early childhood Education – Early childhood development*. https://ecdtraining.com/the-benefits-of-storytelling-in-early-childhood-education
- Landrum, E., McCarthy, M. & Brakke, K. (2019). *The Pedagogical Power of Storytelling.* Scholarship of Teaching and Learning in Psychology. https://www.researchgate.net/publication/335193649_The_pedagogical_power_of_storytelling

- Lisenbee, P.S. & Ford, C.M. (2017). *Engaging Students in Traditional and Digital Storytelling to Make Connections Between Pedagogy and Children's Experiences.* Early Childhood Education Journal. https://dshutkinedtech.education/wp-content/uploads/2019/01/lisenbeeford2018digitalstorytellingearlychildhood.pdf
- Nair, A. (2024). *Exploring Campbell's Hero's Journey framework*. Libriperx. https://libriperx.com/articles/campbells-hero-journey-framework/
- Peroni, M. (2024). *Narratives of Unity: The Imperative of Storytelling in Diversity and Inclusivity Education.* The New Renaissance Mindset. https://renminds.org/2024/04/21/narratives-of-unity-the-imperative-of-storytelling-in-diversity-and-inclusivity-education/
- Reading Rockets. (n.d.). *Accommodations and Modifications.* Reading Rockets. https://www.readingrockets.org/helping-all-readers/inclusive-classrooms/accommodations-and-modifications
- Tripon, C. (2024). *Bridging Horizons: Exploring STEM students' perspectives on Service-Learning and storytelling activities for community engagement and gender equality.* Trends in Higher Education, 3(2), 324-341. https://doi.org/10.3390/higheredu3020020

Chapter 2: Framework for creating effective educational stories

References

- Bruner, J. (1991). *The Narrative Construction of Reality*. Critical Inquiry, 18(1).
- Bruner, J. (2004). Life as Narrative. *Social Research: An International Quarterly 71*(3), 691-710. https://dx.doi.org/10.1353/sor.2004.0045
- Buckley, C., Farrell, L., & Tyndall, I. (2021). Brief stories of successful female role models in science help counter gender stereotypes regarding intellectual ability among young girls: A pilot study. *Early Education and Development, 33*(1). https://doi.org/10.1080/10409289.2021.1928444
- Collins, S. N. (2021). The importance of storytelling in chemical education. *Nature Chemistry, 13*(1), 1-2. https://doi.org/10.1038/s41557-020-00617-7
- Dujmović, M. (2006). Storytelling as a method of EFL teaching. *Metodički obzori : časopis za odgojno-obrazovnu teoriju i praksu*, 1(1), 75-87. https://hrcak.srce.hr/11514

- Egan, K. (1986). *Teaching as Storytelling: An Alternative Approach to Teaching and Curriculum in the Elementary School*. University of Chicago Press.
- Egan, K. (1998). *The educated mind: How cognitive tools shape our understanding*. *Bibliovault OAI Repository, the University of Chicago Press*, 68. https://doi.org/10.2307/1585992
- McLellan, H. (2006). Digital storytelling in higher education. *Journal of Computing in Higher Education*, 19(1), 65–79.
- Muir, C., Dörnyei, Z., & Adolphs, S. (2019). Role models in language learning: Results of a large-scale international survey. *Applied Linguistics, 42*. https://doi.org/10.1093/applin/amz056
- Murphy, S. T., Frank, L. B., Chatterjee, J., & Baezconde-Garbanati, L. (2011). Involved, transported, or emotional? Exploring the determinants of change in knowledge, attitudes, and behavior in entertainment-education. *Communication Theory, 21*(4), 317–336. https://doi.org/10.1111/j.1468-2885.2011.01398.x
- Vistas Learning. (2024, November 20). *Benefits of animation in learning and development*. Vistas Learning Blog. https://blog.vistaslearning.com/benefits-of-animation-in-learning-and-development/

Further reading

- Catala, A., Theune, M., Gijlers, H., & Heylen, D. (2017). Storytelling as a creative activity in the classroom. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (pp. 237–242). https://www.researchgate.net/publication/317868640_Storytelling_as_a_Creative_Activity_in_the_Classroom – Explores the use of storytelling activities, supported by digital tools, to enhance creativity in children and develop 21st-century skills.
- Gambrell, L. B., & Marinak, B. A. (2009). "Reading Motivation: What the Research Says" (*The Reading Teacher*) – Discusses engagement through written narratives.
- González González, C., Starosky, P., & Pereira, M. (2013). Role-playing game as a pedagogical proposition for story co-construction. In *Teaching and learning in 21st-century classrooms* (pp. 274–292). https://www.researchgate.net/publication/265066812_Storytelling_in_Teaching – Highlights the power of storytelling as an unforgettable and engaging way to learn and transmit knowledge, emphasising its emotional and cognitive impact over other methods of teaching.

- Green, M. (2004). Storytelling in teaching. *Association for Psychological Science Observer, 17*. https://www.researchgate.net/publication/265066812_Storytelling_in_Teaching – Explores the use of storytelling as an effective tool in teaching and education, particularly in the context of psychology and social sciences.
- Lambert, J. (2002). Digital storytelling: Capturing lives, creating community. https://www.researchgate.net/publication/281562738_Digital_Storytelling_Capturing_lives_Creating_Community – Explores digital storytelling as a learning method.
- Reynolds, K., & Zipes, J. (2008). Why fairy tales stick: The evolution and relevance of a genre. *The Modern Language Review,* 103, 503. https://www.researchgate.net/publication/289930155_Why_Fairy_Tales_Stick_The_Evolution_and_Relevance_of_a_Genre

Chapter 3: Strategies for implementing storytelling in the classroom

References

- Lenhart, J., Lenhard, W., Vaahtoranta, E., & Suggate, S. (2020). *More than words: Narrator engagement during storytelling increases children's word learning, story comprehension, and on-task behavior*. Early Childhood Research Quarterly, Vol. 51, 338-351. https://doi.org/10.1016/j.ecresq.2019.12.009
- Manganello, F., & Baldacci, M. (2024). Digital Stories and Inclusive Cultures at School: A Research Study in an Italian Primary Multicultural Classroom. *Education Sciences*, *14*(10), 1108. https://doi.org/10.3390/educsci14101108
- Miller, C., & Robertson, A. (2021). *Using storytelling to bridge diverse learning needs: A classroom study*. Journal of Special Education, 55(3), 215-228. https://doi.org/10.1177/0022466921992780
- Paciga, K. & Lisy, J. & Teale, W. & Hoffman, J. (2022). Child Engagement in Classroom Read-Alouds: Considering Seating and Timing. Illinois Reading Council Journal. 50. 38-46. https://doi:10.33600/IRCJ.50.4.2022.38
- Oktaviani, E., Ilham, I., Lukman, L., Olatunji, S. O., & Whitworth, N. (2024). The effect of show and tell, role-play and storytelling on speaking skills: A meta-analysis. Journal of Languages and Language Teaching, 12(2), 846-858. https://doi.org/10.33394/jollt.v12i2.10868

- Walan, S. (2017). Teaching children science through storytelling combined with hands-on activities – a successful instructional strategy? Education 3-13. 47. 1-13. https://doi:10.1080/03004279.2017.1386228

Further reading

- Cremin, T., Swann, J., Flewitt, R., Faulkner, D., & Kucirkova, N. (2017). *Storytelling and story-acting: Co-construction in action. Journal of Early Childhood Research.* 16. 10.1177/1476718X17750205. https://doi.org/10.1177/1476718X17750205
- Gopnik, A. (2020). The Gardener and the Carpenter: What the New Science of Child Development Tells Us About the Relationship Between Parents and Children. *Picador.*
- Isbell, R., Sobol, J., Lindauer, L., & Lowrance, A. (2004). The Effects of Storytelling and Story Reading on the Oral Language Complexity and Story Comprehension of Young Children. Early Childhood Education Journal, 32(3), 157-163. https://doi.org/10.1023/B:ECEJ.0000048967.94189.a3
- Lenhart, J., Lenhard, W., Vaahtoranta, E., & Suggate, S. (2020). *More than words: Narrator engagement during storytelling increases children's word learning, story comprehension, and on-task behavior*. Early Childhood Research Quarterly, Vol. 51, 338-351. https://doi.org/10.1016/j.ecresq.2019.12.009

Chapter 4: Assessment and reflection through storytelling

- Barchas-Lichtenstein, J., Sherman, M., Voiklis, J., & Clapman, L. (2023). Science through storytelling or storytelling about science? Identifying cognitive task demands and expert strategies in cross-curricular STEM education. *Frontiers in Education, 8*. https://doi.org/10.3389/feduc.2023.1279861
- Borsotti, V. (2018). Barriers to gender diversity in software development education: Actionable insights from a Danish case study. In *Proceedings of the 40th International Conference on Software Engineering: Software Engineering Education and Training* (pp. 146-152).
- Botella, C., Rueda, S., López-Iñesta, E., & Marzal, P. (2019). Gender diversity in STEM disciplines: A multiple factor problem. *Entropy, 21*(1), 30. https://doi.org/10.3390/e21010030
- Brussino, O., & McBrien, J. (2022). Gender stereotypes in education. *OECD Education Working Papers*, (271). https://doi.org/10.1787/a46ae056-en

- Chiangpradit, L. (2023). Alternatives to standardized STEM testing. *STEM Sports*. https://stemsports.com/alternatives-to-standardized-stem-testing/
- Cohen, S. M., Hazari, Z., Mahadeo, J., Sonnert, G., & Sadler, P. M. (2021). Examining the effect of early STEM experiences as a form of STEM capital and identity capital on STEM identity: A gender study. *Science Education, 105*(6), 1126–1150. https://doi.org/10.1002/sce.21670
- Corbett, C., & Hill, C. (2015). *Solving the equation: The variables for women's success in engineering and computing*. American Association of University Women.
- Engel, A., Lucido, K., & Cook, K. (2018). Rethinking narrative: Leveraging storytelling for science learning. *Childhood Education, 94*(6), 4–12. https://doi.org/10.1080/00094056.2018.1540189
- Farias, S. S. (2021). O PISA 2018 e a educação STEM das raparigas. *Instituto de Sociologia da Universidade do Porto*. http://www.barometro.com.pt/2021/08/02/o-pisa-2018-e-a-educacao-stem-das-raparigas/
- Gilchrist, E., & Zhang, K. C. (2022). Gender stereotypes in the UK primary schools: Student and teacher perceptions. *International Journal of Educational Reform*, *33*(3), 270–294. https://doi.org/10.1177/10567879221114889
- Gouvêa, M., Santoro, F., Cappelli, C., Motta, C., & Borges, M. (2019). *EPOS: The hero's journey in organizations through group storytelling*. https://doi.org/10.1109/CSCWD.2019.8791860
- Harris, R. (2017). *Elaborating on the theme of transformation. The Hero's Journey: Life's Great Adventure*. https://www.yourheroicjourney.com/rethinking-campbell-when-stages-are-not-stages-2/
- Hsu, J.-L., Chou, H.-W., & Chang, H.-H. (2011). EduMiner: Using text mining for automatic formative assessment. *Expert Systems with Applications, 38*(4), 3431–3439. https://doi.org/10.1016/j.eswa.2010.08.129
- Liu, Y. (2013). Preliminary study on application of formative assessment in college English writing class. *Theory and Practice in Language Studies, 3*(12), 2186–2195. https://doi.org/10.4304/tpls.3.12.2186-2195
- Morais, C. (2015). Storytelling with chemistry and related hands-on activities: Informal learning experiences to prevent "chemophobia" and promote young children's scientific literacy. *Journal of Chemical Education, 92*(1), 58–65. https://doi.org/10.1021/ed5002416

- Morais, C. (2020). Storytelling and hands-on activities boosting young children's awareness and understanding of chemistry. *L'Actualité Chimique, 447*, 43-47.
- Morais, C., Moreira, L., & Ferreira, A. C. (2025). A comunicação de ciência através de histórias de vida no feminino. In *SciComPt2024 – Linguagens e vozes para uma ciência acessível* (pp. 151-155). SciComPt. https://doi.org/10.5281/zenodo.14643540
- Morais, C., Moreira, L., Baptista, M., & Martins, I. (2021). Digital tools entering the scene in STEM activities for physics teaching. In A. Reis (Ed.), *Technology and innovation in learning, teaching and education TECH-EDU 2020. Communications in computer and information science*. Springer.
- Nirmala, K. (2020). Assessment and culture. In *Teaching early years: Curriculum, pedagogy and assessment* (pp. 271-284). https://doi.org/10.4324/9781003117704-21
- OECD. (2019). *Education at a glance 2019: OECD Indicators*. https://doi.org/10.1787/f8d7880d-en
- OECD. (2022). *Gender stereotypes in education: Policies and practices to address gender stereotyping across OECD education systems* (OECD Education Working Papers No. 271). https://doi.org/10.1787/a46ae056-en
- OECD. (2024). *Challenging social inequality through career guidance*. https://doi.org/10.1787/619667e2-en
- Paiva, A., Gomes, A., Silva, V., Machado, I., & Dias, R. (2019). O storytelling e a literacia científica. *Revista Ciência Elementar, 7*(3). https://doi.org/10.24927/rce2019.051
- Piloto, C. (2023). The gender gap in STEM. *MIT Professional Education*. https://professionalprograms.mit.edu/blog/leadership/the-gender-gap-in-stem/
- PISA. (2022). *PISA 2022 results (Volume I): The state of learning and equity in education*. OECD. https://www.oecd-ilibrary.org/sites/53f23881-en/index.html
- ProctorEdu.com. (n.d.) *Hands-on learning – Definition & meaning*. https://proctoredu.com/glossary/hands-on-learning
- Prost, M., Piermattéo, A., & Lo Monaco, G. (2022). Social representations, social identity, and representational imputation: A review and an agenda for future research. *European Psychologist, 28*. https://doi.org/10.1027/1016-9040/a000489

- Rhodes, M. G. (2019). Metacognition. *Society for the Teaching of Psychology, 46*(2), 168–175. https://doi.org/10.1177/0098628319834381
- Sebastian-Tirado, A., Felix-Esbri, S., Forn, C., & Sanchis-Segura, C. (2023). Gender stereotypes selectively affect the remembering of highly valued professions. *Sex Roles*. https://doi.org/10.1007/s11199-023-01355-z
- Singh, M. (2021). Acquisition of 21st century skills through STEAM education. *Academia Letters*, Article 712. https://doi.org/10.20935/AL712
- Spencer, S. J., Logel, C., & Davies, P. G. (2016). Stereotype threat. *Annual Review of Psychology, 67*, 415–437. https://doi.org/10.1146/annurev-psych-073115-103235
- Sullivan, K., Byrne, J. R., Bresnihan, N., O'Sullivan, K., & Tangney, B. (2015, October). CodePlus—Designing an after school computing programme for girls. In *2015 IEEE Frontiers in Education Conference (FIE)* (pp. 1–5). IEEE.
- UNESCO. (2017). *Cracking the code: Girls' and women's education in science, technology, engineering and mathematics (STEM)*. https://unesdoc.unesco.org/notice?id=p::usmarcdef_0000253479

Chapter 5: Adapting and integrating storytelling into the curriculum and context

- Hu, J., Gordon, C., Yang, N., & Ren, Y. (2021). "Once upon a star": a science education program based on personification storytelling in promoting preschool children's understanding of astronomy concepts. *Early Education and Development*, 32(1), 7–25. https://doi.org/10.1080/10409289.2020.1759011
- STEAM Tales Project. (n.d.). *STEAM Tales: Role models and storytelling to foster girls' engagement in STEAM*. Erasmus+ Programme. https://steamtales.eu

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