Computational Storytelling Approach in Language for Technical Concepts in Engineering Curricula

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Abstract
One of the most important skills for engineering graduates is the ability to properly express complicated technological topics. Grammar and vocabulary are frequently prioritized in traditional language training, but domain-specific technical knowledge is not integrated. In order to improve technical literacy and communication abilities in engineering language courses, this study suggests a Computational Storytelling Approach that makes use of interactive simulations, artificial intelligence, and narrative frameworks. Students may understand procedures, express ideas clearly, and hone their professional writing and presenting skills by turning abstract engineering topics into structured tales. The approach incorporates multimodal representations, such as diagrams, written explanations, and dynamic simulations, and is backed by AI-driven feedback on linguistic fluency and technical accuracy. Improvements in understanding, involvement, and the capacity to successfully communicate complicated technical information are demonstrated by the pilot implementation. According to the results, computational storytelling provides a scalable and cutting-edge teaching method for engineering education by bridging the gap between academic knowledge and communicative competence.
Keywords: AI-assisted pedagogy, Computational storytelling, Engineering communication, Engineering Language Curricula, Multimodal learning, Language curricula, Technical Concepts & Technical literacy

INTRODUCTION

A cutting-edge pedagogical strategy that blends the ideas of narrative learning with computing resources like artificial intelligence, interactive exercises, and multimodal visualisation platforms is computational storytelling, which has gained popularity in recent years. [1] Students can better understand abstract engineering topics by presenting technical ideas as stories with characters, narratives, and cause-and-effect sequences. Additionally, this method promotes the integration between linguistic and technical knowledge, critical thinking, and creative problem-solving. [16, 19]
Although it is still a constant problem in engineering education, successful interaction of technical information is a fundamental ability for engineering graduates.[2] Traditional language training emphasizes vocabulary, grammar, and fundamental writing abilities, but it frequently ignores the domain-specific literacy needed to accurately and cogently explain intricate technical phenomena. In order to create narratives that are understandable, organized, and captivating for a variety of audiences, engineering students usually find it difficult to interpret abstract ideas, procedures, and data. [10,27]
Students' comprehension and communication abilities are improved by the Computational Storytelling Approach, which uses textual descriptions, illustrations, animations, and AI-assisted feedback to help them express complicated ideas. By incorporating this strategy into engineering language programs, it is anticipated that graduates will be better prepared to thrive in multidisciplinary and cooperative engineering settings by bridging the gap between technical proficiency and proficient professional communication. [3,4]

Through creative, narrative-driven pedagogy, computational storytelling has the potential to revolutionize technical education. This study examines the design, implementation and results of computational storytelling in engineering classrooms. [21.22,34]

I. Background Foundations of Theory

- **Frameworks for Computational Thinking (CT)**

Problem-solving techniques like abstraction, decomposition, pattern detection, and algorithmic thinking are all part of CT. It has been demonstrated that incorporating CT into the classroom enhances students' capacity for critical thought and problem-solving.[5]

- **Using Digital Storytelling (DST) as a Teaching Aid**

DST creates captivating narratives by fusing digital technologies with classical storytelling. It has been used to develop critical thinking, creativity, and communication abilities. DST can help make difficult technical ideas more relevant and intelligible in the context of engineering education. [6,7]

- **Combining DST and CT**

Combining CT with DST creates a dynamic teaching framework. Through this integration, students are able to create narratives that illustrate problem-solving techniques in addition to providing technical information. It has been discovered that this method improves students' motivation and performance.[10]

I.2 Pedagogical Implications for Education

Students' attention is captured and learning becomes more interesting when narrative patterns are used. Students are better able to relate to and remember complex material when technical content is woven into narrative. Students must use CT abilities like decomposition and pattern detection in a creative setting when developing digital stories. [28] In addition to strengthening technical knowledge, this fosters the growth of critical problem-solving and creative skills. Better Communication Students studying engineering frequently find it difficult to explain complicated concepts clearly. DST gives students a chance to hone their communication abilities and make complex ideas more understandable to a range of audiences. [26,29]

I.3 Practical Applications

There are several ways to include computer science (CS) in engineering language courses:

- **Project-Based Learning:** As part of their assignments, students may be asked to produce digital narratives that describe technical ideas or procedures. [7]
- **Collaborative Story Creation**: Group exercises in which students work together to create stories that combine storytelling components with technical information.
- **Multimedia Integration:** Making use of resources and systems that let students add interactive elements, sound, and images to their narratives.[9]

I.4 Purpose of the Study

The main goal of this research is to find out how well a computational narrative approach may help engineering graduates better understand, articulate, and communicate technical ideas. By bridging the gap between technological knowledge and linguistic skills, the study hopes to help students communicate difficult engineering concepts in a clear, creative, and cohesive manner. The research aims to offer a scalable and creative framework for building language courses by fusing narrative pedagogy with computer technologies including artificial intelligence (AI), interactive exercises, and multimodal visualization. [1,2,8]

I.5 Objectives of the Study

- To provide a framework for computational storytelling that converts technical engineering ideas into organized, narrative-based educational materials. [16]
- To improve technical literacy and understanding by giving students the ability to explain, envision, and analyze intricate engineering procedures. [34]

- To enhance engineering communication abilities by incorporating text, diagrams, and exercises into multimodal representations.
- To assess how well AI-assisted feedback improves narrative coherence and technical writing. [10]
- To evaluate students' motivation, engagement, and critical thinking when using computational storytelling in language training.[15]
- To offer suggestions for integrating narrative-driven computational pedagogy for long-term, sustainable literacy development into current engineering curricula.[30]

2. Language Key Elements of the **Computational Storytelling Approach** that can be integrated into engineering language curricula:

- **Terminology and Technical Lexis**

Pay close attention to how technical terms like "algorithm," "simulation," "load-bearing," and "optimization" are used. Contextual storytelling serves to reinforce discourse relevant to a given domain. Motivates pupils to convert difficult jargon into language suitable for the target audience. [8,28]

- **Storytelling Framework**

Technical processes are framed using story arcs, which include beginning, problem/conflict, and resolution. Incorporates process-oriented and cause-effect sequences (e.g., input → process → output). Promotes consistency and logical development while explaining technical workflows.[24]

- **Logic and Computational Syntax**

Incorporates iterative, procedural, and conditional expressions (such as "if–then," "loop," and "function"). Promotes linguistic analogies between narrative grammar and coding architecture. Encourages algorithmic reasoning by using linguistic scaffolds such as flow markers, connectors, and transitions. [17,18]

- **Expression in Multiple Modes**

Integrates coded, symbolic, or visual components (charts, pseudocode, diagrams) with textual narration. Creates digital multimodality, which is the capacity to communicate meaning using both computational and linguistic media.[10]

- **Analogical and Metaphoric Words**

Humanizes abstract technical ideas with metaphors and analogies (e.g., "data moves like water through pipes"). Makes it easier to conceptually bridge engineering theory to real-world experience. [11]

- **Logical Connectors and Discourse Markers**

Uses indicators like hence, consequently, in comparison, and as a result to improve coherence and clarity. Improves the readability for scientific narratives and reflects computational shifts.[17]

- **Descriptive and Expository Modes:** Promotes explanatory storytelling for conceptual clarity and describing narration for technical procedures. Encourages the use of narrative form to explain structure, function, and purpose.[23]
- **Framing Problems and Solutions**

Using the principles of engineering design thinking methodology (issue identification, analysis, solution, and assessment) in storytelling. Fosters a communication style that is focused on finding solutions.[12]

- **Audience-Centered Communication:** This approach emphasizes adjusting tone, voice, and details based on the audience, which may include clients, general readers, or peer engineers. By using contextual awareness, it strengthens academic and professional writing abilities. [35]
- **Introspective and Evaluative Language**

Incorporates reflective expressions such as "the outcome indicates," "this approach highlights," etc. Promotes metacognitive knowledge of the language and computing processes themselves.

3. Recent Studies on Computational Storytelling Approach

Hyungjun Doh, Jingyu Shi, Rahul Jain, Heesoo Kim, and Karthik Ramani (2025 Year) examine the growing prominence of storytelling in Augmented Reality (AR), highlighting its potential due to the multi-modal and interactive nature of AR environments. To address this gap, the researchers conducted an exploratory analysis of 223 AR video stories, from which they developed a design space framework for multi-modal AR storytelling. Building on this framework, they created a testbed that enables integrated content generation and facilitates experimentation with key narrative components. Through two user studies involving 30 experienced storytellers and live presenters, the researchers examined (1) participants' preferences for different narrative modalities, (2) their interactions with AI during the creative process, and (3) the perceived quality of the AI-generated AR content. The findings provide design considerations and guidelines for future development of AR storytelling systems that incorporate GenAI-driven content generation.

Sakthivel, Aruldoss, and colleagues (2025) highlight digital storytelling as an emerging pedagogical approach that integrates narrative expression with digital media, particularly within English as a Second Language (ESL) learning in higher education. Their study explored the influence of digital storytelling on motivation, learner engagement, and language proficiency among tertiary-level ESL students. Using a mixed-method survey design, data were collected from a diverse group of learners across multiple colleges. The findings revealed a notable increase in both intrinsic and extrinsic motivation among students who participated in digital storytelling tasks. In addition, the researchers observed higher levels of learner engagement, suggesting that digital storytelling fosters more active and meaningful learning experiences. Importantly, the study also identified a positive relationship between digital storytelling practices and improved language proficiency, indicating enhancement in linguistic expression and communicative confidence. Overall, the study underscores the pedagogical value of digital storytelling and recommends its integration into university-level ESL instruction to promote more interactive, student-centered, and motivationally rich learning environments.

Esther-del-Moral-Pérez, López-Bouzas, and Castañeda-Fernández (2025Year) emphasize the role of Computational Thinking (CT) as a foundational cognitive skill encompassing abstraction, generalization, algorithmic reasoning, and evaluative thinking—abilities that support logical problem-solving in increasingly digitized learning environments. In their pre-experimental study involving 82 children aged 4 to 6, the researchers implemented an individualized intervention structured around a digital storytelling scenario. In this narrative, learners assisted a robot character in helping a turtle recover its habitat by programming the robot to navigate specific routes and overcome challenges. This study demonstrates that narrative-based, playful programming activities can effectively foster early computational thinking, highlighting the pedagogical value of story-driven learning experiences in STEM and early childhood education. To evaluate the development of CT skills, the authors designed and validated the CT-Robot-DST Scale, comprising 14 indicators across four performance levels. The scale measured competencies such as task planning and sequencing, spatial orientation, logical reasoning, understanding programming commands, memorization, coordination, and problem-solving. The findings revealed that most children were highly engaged with the story and actively participated in task execution. Notably, 78.1% of the learners reached levels close to high CT competence, with more autonomous students showing particularly strong performance.

Shemy, (2023) investigated on Digital storytelling that (DST) has been recognized as an effective pedagogical tool that enhances learning outcomes by promoting deeper comprehension and engagement, particularly in higher education contexts. Shemy (2023) conducted a mixed-methods study among master's students in instructional technology at the Arab Open University in Oman to examine their perceptions of DST in understanding practical concepts. The study involved 67 participants who completed a structured questionnaire, while qualitative insights were obtained from semi-structured interviews with ten students. Findings revealed that students perceived DST as a meaningful and enjoyable learning approach that supported deep understanding, active engagement, and constructive knowledge building. The most positive perceptions were associated with DST's ability to enhance information retention, facilitate the application of concepts in varied contexts, and improve problem-solving skills ($M = 4.186$, $SD = 0.7371$; $M = 4.051$, $SD = 0.7558$; $M = 4.023$, $SD = 0.7531$ respectively). However, perceptions were less positive regarding its effectiveness in supporting analytical and discussion-based learning tasks ($M = 2.056$, $SD = 1.209$). Overall, the study concluded that DST not only strengthened conceptual understanding and practical application but also increased students' motivation and interaction with learning content.

4. Advantages of the **Computational Storytelling Approach for Technical Concepts in Engineering Language Curricula**

- **Improves Conceptual Knowledge**

Makes difficult technical concepts easier to understand by transforming them into narrative situations. Promotes a greater understanding of engineering concepts by using visuals and reasoning based on stories. Promotes long-term retention by bridging the gap between technical reasoning and human cognition.[5]

- **Encourages Multidisciplinary Education**

Promotes comprehensive education by bridging language, engineering, and computational thinking. Motivates pupils to combine artistic expression with technical precision. Encourages the merging of STEM and humanities curricula.[34]

- **Fosters the Development of Communication Skills**

Enhances conversational communication, digital storytelling, and technical writing abilities. Assists students in clearly communicating intricate procedures to a range of audiences. Enhances the capacity to clearly communicate computational reasoning, experimental results, and design justifications.[35]

- **Promotes Computational and Critical Thinking: Students are encouraged to think like programmers and problem solvers while logically organizing stories.**

Uses linguistic scaffolding to reinforce algorithmic thinking, sequencing, and if-then reasoning. Fosters higher-order thinking by tying narrative coherence and computational logic together.[31]

- **Fosters Innovation and Creativity**

Encourages students to employ scenario-based learning, coding metaphors, and story-driven simulations. Encourages creative methods for analyzing and presenting technical data. Combines innovative creativity with analytical precision.[20]

- **Promotes Multimodal Knowledge**

Creates coherent communicative outputs by combining text, code, images, and data. Improves students' proficiency with digital content creation and navigation in engineering situations. Complements the Industrial 4.0 and AI-era proficiencies in design thinking and digital communication.[23]

- **Encourages Experience-Based and Collaborative Learning**

Supports group storytelling initiatives that include technical explanation, narrative scripting, and coding. Promotes peer education using interactive online narrative tools. Encourages conversation, active engagement, and the development of collective knowledge.[5]

- **Enhances Engagement and Motivation**

Story-based assignments help people relate to and enjoy technical subjects. By tying academic material to real-world situations, learners become more motivated. By using contextual learning and story pacing, it lessens cognitive stress.[32]

- **Enhances Ethical and Reflective Awareness**

Encourages contemplation of how engineering advancements affect society, ethics, and the environment. Inspires developers to think about the human side of technology. Fosters thoughtful and compassionate communication.

- **Gets Graduates Ready for the Future**

Gives students the computational, communication, and creative thinking abilities needed in today's engineering sectors. Boosts employability by developing both technical proficiency and narrative intelligence. Gets students ready for transdisciplinary, globally networked, AI-assisted workplaces. [14,26]

5. CONCLUSION

A paradigm shift in engineering language instruction is represented by the Computational Storytelling Approach, which combines the expressive potential of narrative with the analytical accuracy of computer. This method helps engineering students comprehend, express, and apply complicated ideas more creatively and clearly by integrating technical concepts into narrative frameworks. By combining reasoning, language, and digital literacy, it goes beyond conventional teaching methods and enables students to communicate algorithms, concepts, and engineering procedures through compelling verbal and visual storytelling.

Students gain multifaceted competencies through computational storytelling, including the ability to think critically, communicate clearly, and create contextually in technology fields. In addition to improving understanding and retention, the method fosters interdisciplinary intelligence, which is crucial for international engineering communications in the age of artificial intelligence and Industry 4.0. Additionally, it encourages teamwork, introspection, and ethical consciousness, assisting aspiring engineers in explaining the human value of their technological advancements.

Finally, the Computational Storytelling Framework provides a potent teaching framework that transforms the way technical knowledge is conveyed and assimilated in engineering programs. It positions storytelling as a fundamental component of future-oriented engineering education by encouraging teachers to see language as an evolving medium for computational creativity, and intellectual transformation rather than just a tool for description.

6. Recommendations

- Include computational exercises based on storytelling in the technical writing and engineering communication curricula. Encourage students to use narrative formats, including case-based simulations, algorithmic scripts, or digital storytelling, to convey engineering principles.[4]

- Work together across disciplines, including language studies, computer science, and engineering, to jointly develop modules that combine narrative discourse and computational logic.
- Create collaborative evaluation criteria that prioritize both verbal clarity and technical precision.
- To facilitate multimodal storytelling, make use of platforms like coding visualizers, AI-based tale generators, and story-mapping tools. [10]
- Promote the use of programming environments and interactive media (such as Scratch and the Python visual storytelling libraries) for imaginative educational opportunities.[15]
- Provide teachers with professional development courses that combine narrative teaching with computational thinking. Teach teachers to assess students' narratives for computational reasoning in addition to language proficiency.[16]
- Lead group storytelling initiatives in which students jointly produce digital tales that describe engineering discoveries or procedures. [12]
- Reviews from peers and presentation sessions should be integrated to enhance interdisciplinary discourse and communication confidence.
- Encourage students to incorporate sociological, ethical, and environmental aspects into their computational narratives. Reiterate that engineer narratives are human-centered in addition to technical.[33]
- Create evaluation instruments that gauge language coherence as well as computational fluency. Make use of performance-based evaluation tools including data-driven narrative artifacts, narrated programming projects, and digital portfolios.[21]
- Aid in classroom studies investigating how computational storytelling affects conceptual mastery, creativity, and language competency. Encourage creativity by means of multidisciplinary forums on digital and storytelling teaching and institutional grants.[34]
- Promote an academic environment where computing, visualization, and storytelling are all accepted forms of research.
- Acknowledge innovative computational narratives as beneficial products of teaching engineering communication.[11]
- Make sure computational activities that incorporate narrative are in line with future skill requirements, such as interdisciplinary cooperation, data communication, and AI literacy. Train engineering graduates to be proficient storytellers who can convey concepts in both technical and non-technical fields.[35]

7. Implications

- The Computational Storytelling Approach has significant ramifications for the pedagogical and practical reform of engineering language instruction. [24]
- By combining creativity, communication, and computation into a single learning process, it completely reimagines how students interact with technical ideas.
- This strategy suggests a paradigm change away from conventional lecture-based teaching techniques and toward interactive, narrative-centered learning settings where technical knowledge is created via coding, visualization, and storytelling.[28]
- Pedagogically, by focusing on process-oriented and experiential learning, it challenges teachers to reconsider curriculum design, evaluation, and instructional strategies. By encouraging cognitive flexibility, the method enables pupils to switch between computational reasoning and narrative language with ease. [36,37]
- Because it broadens the definition of literacy to encompass digital, multidimensional, and algorithmic literacies—all of which are crucial in modern engineering contexts—it also has consequences for language instruction.[34]

- Adopting computational storytelling at the institutional level necessitates faculty training and curriculum modification in order to incorporate narrative-based computational activities into technical and communication courses.
- To create coherent learning experiences, it urges the development of interdisciplinary partnerships involving computer scientists, engineers, and language specialists.
- Professionally speaking, this method gives engineering graduates the skills they need for the future, such as the capacity to explain intricate technical phenomena, interact with people from different fields, and create through computational creativity. [38]
- As a crucial cognitive and communication instrument for knowledge building, ethical reflection, and technical growth in the age of digital change, the consequences of this method ultimately go beyond schooling.[39]

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