

## Humanizing Science: A Narrative Inquiry into the Integration of Historical Context in STEM Education

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### ABSTRACT

**Background.** The integration of historical context in STEM education has gained increasing attention as a means to enhance student engagement and comprehension. STEM fields, traditionally perceived as highly technical, often lack connections to real-world applications and human stories. By incorporating historical narratives into STEM curricula, educators can humanize the subject matter and make scientific concepts more relatable.

**Purpose.** This study explores the role of historical context in STEM education through a narrative inquiry approach. The research aims to investigate how educators incorporate history into their teaching practices and the impact this integration has on students' learning experiences.

**Method.** A qualitative approach was employed, utilizing interviews and reflective journals from STEM educators and students.

**Results.** The findings reveal that incorporating historical context significantly enhances student engagement, fosters a deeper understanding of scientific concepts, and increases the relevance of STEM subjects in students' lives. The study also highlights the challenges educators face in integrating history into their teaching, particularly in terms of curriculum constraints and the lack of resources.

**Conclusion.** The research concludes that historical context is a valuable tool in humanizing STEM education, making it more engaging and accessible. This approach promotes a more holistic understanding of science, emphasizing its societal relevance and the human dimensions behind scientific discoveries.

### KEYWORDS

Educational Innovation, History in STEM, Humanized Science

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## INTRODUCTION

The integration of historical context into STEM (Science, Technology, Engineering, and Mathematics) education has gained increasing attention in recent years, with many educators and scholars advocating for a more humanized approach to teaching these subjects. Traditionally, STEM education has focused primarily on technical knowledge and problem-solving skills, often isolating scientific concepts from their social, historical, and cultural contexts. This approach can lead to a disconnection between students and the relevance of science in their everyday lives (Botaro, 2025; Sierra-Durán, 2025). By incorporating historical perspectives into

STEM education, educators can provide a richer, more comprehensive understanding of how scientific knowledge has evolved and its impact on society. This study aims to explore the potential benefits and challenges of integrating historical context into STEM curricula, using narrative inquiry as a method to understand how educators and students engage with this approach. The increasing push for interdisciplinary teaching and learning underscores the importance of understanding how the human element in scientific inquiry can enrich students' educational experiences and foster a more inclusive view of science.

Despite the growing recognition of the importance of contextualizing science, there remains a significant gap in the literature regarding the practical integration of historical perspectives in STEM education. Most existing studies have focused on the theoretical benefits of connecting STEM with history, but few have investigated the actual implementation of this approach in classroom settings or the specific challenges that educators face when attempting to incorporate history into STEM teaching. Additionally, while some scholars have examined the impact of historical narratives on students' attitudes toward science, there is limited research on how these narratives shape their understanding of scientific concepts and the role of science in society. This study seeks to fill this gap by conducting a narrative inquiry into the experiences of STEM educators who have attempted to integrate historical context into their teaching practices. The goal is to provide practical insights into the challenges and opportunities that arise when attempting to humanize science education and to understand how historical narratives can enhance students' engagement with STEM subjects (Jiang, 2025; Kaya, 2025).

The primary objective of this study is to investigate how the integration of historical context into STEM education can foster a more humanized and engaging learning experience for students. Specifically, the research aims to explore the ways in which educators incorporate historical narratives into their teaching practices, how students respond to these narratives, and what impact these narratives have on their understanding of scientific concepts. The study also seeks to identify the pedagogical strategies that educators use to effectively integrate history into STEM curricula and the barriers they encounter in doing so. By focusing on the lived experiences of educators and students, this study will provide valuable insights into the potential of historical narratives to bridge the gap between scientific knowledge and social context, thereby making STEM education more relevant and accessible. The findings of this research could inform curriculum development and teaching strategies, offering guidance for educators who seek to adopt a more inclusive and interdisciplinary approach to teaching science (Pesode, 2025; Tsogtsaikhan, 2025).

While existing literature on STEM education has explored the integration of interdisciplinary themes such as ethics, social responsibility, and technology, there is a notable gap in the exploration of historical context as a pedagogical tool. Studies that have focused on the historical aspects of science education often treat them as peripheral elements, rather than integral components of the learning experience (Fekrvand, 2025; Franco-Fuquen, 2025). Additionally, while some research has examined the benefits of contextualizing science, few studies have utilized narrative inquiry, a qualitative research method that emphasizes the personal and social aspects of learning. Narrative inquiry allows for a deeper understanding of how individuals make sense of their experiences, providing insights into the personal and social dimensions of learning that are often overlooked in traditional research approaches. This study contributes to the existing literature by focusing on the specific role of historical context in STEM education and by using narrative inquiry to capture the subjective experiences of educators and students. The research also highlights the potential of this approach to foster critical thinking, promote social awareness, and humanize the teaching of STEM subjects (Kumar, 2025; Sun, 2025).

The novelty of this research lies in its exploration of the intersection between history, science, and education, an area that has received limited attention in existing studies. By focusing on the personal and professional narratives of educators, this study provides a unique perspective on the practical challenges and rewards of integrating historical context into STEM teaching (Sánchez-Fuentes, 2025; Silva, 2025). The study also advances the field by demonstrating the potential of historical narratives to deepen students' understanding of scientific concepts, foster a more meaningful engagement with science, and promote a more inclusive and socially responsible view of scientific inquiry. Furthermore, the study's use of narrative inquiry allows for a rich, qualitative exploration of the complexities of teaching and learning in the context of digital and traditional educational settings. As STEM education continues to evolve, this research contributes to the ongoing conversation about how to make science more relevant, inclusive, and engaging for students across diverse backgrounds. By providing insights into the benefits and challenges of integrating history into STEM curricula, this study offers valuable guidance for educators and policymakers seeking to improve science education in the 21st century (Campbell, 2025; Wagle, 2025).

## **RESEARCH METHODOLOGY**

### **Research Design**

This study employs a qualitative research design using narrative inquiry to explore the integration of historical context in STEM education. Narrative inquiry is particularly suited for this research because it allows for an in-depth examination of personal and professional stories, providing insights into how educators experience and implement the integration of historical perspectives in their teaching practices. The design aims to capture the lived experiences of STEM educators who incorporate history into their curricula, as well as the impact of these practices on students' engagement with scientific concepts. Through a series of semi-structured interviews and reflective journals, this study will investigate how educators narrate their experiences of using historical context in STEM education, and how these narratives influence both their teaching approaches and students' learning outcomes. The research will also explore the challenges and benefits of such an integration, providing a comprehensive understanding of its impact on STEM education (Vij, 2025; Zugasti, 2025).

### **Population and Samples**

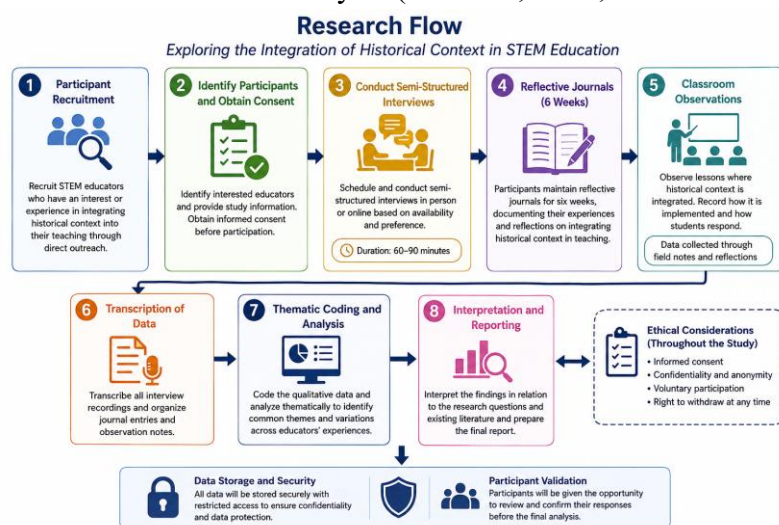
The population for this study consists of STEM educators from diverse educational settings, including secondary schools, higher education institutions, and vocational training centers. The sample will be selected through purposive sampling, focusing on educators who have actively integrated historical context into their STEM curricula. A total of 20 educators will be selected from various disciplines, such as physics, chemistry, engineering, and mathematics, ensuring a broad representation of STEM fields. The sample will include educators from different geographical regions and socio-economic backgrounds to capture a wide range of perspectives on the integration of history in STEM teaching. Additionally, students who have participated in these courses will be invited to share their reflections on how historical context influenced their understanding and interest in STEM subjects. This diverse sample will provide a rich dataset, allowing for an exploration of the various ways in which historical context can be effectively integrated into STEM education (Ding, 2025; John, 2025).

## Instruments

The primary instruments for data collection in this study will be semi-structured interviews, reflective journals, and classroom observations. Semi-structured interviews will be conducted with the selected STEM educators to gather detailed insights into their experiences of incorporating historical context into their teaching practices. These interviews will be guided by a set of open-ended questions, allowing for flexibility and depth in exploring the educators' perspectives. Reflective journals will be used by the educators to document their thoughts, challenges, and successes as they integrate historical narratives into their lessons. These journals will provide a continuous record of their experiences, offering valuable insights into the evolving nature of their teaching practices. Classroom observations will also be conducted to observe how educators present historical context in their lessons and how students engage with these elements. The data collected through these instruments will be analyzed thematically to identify patterns, challenges, and best practices in the integration of historical context in STEM education (Argani, 2025; Soininen, 2025).

## Procedures

The data collection process will begin with the recruitment of participants through direct outreach to STEM educators who have a demonstrated interest or experience in integrating historical context into their teaching. Once the participants have been identified and consented, semi-structured interviews will be scheduled and conducted in person or through online platforms, depending on the availability and preference of the educators. Each interview will last approximately 60-90 minutes and will be recorded for transcription and analysis. Following the interviews, participants will be asked to maintain reflective journals for a period of six weeks, documenting their experiences and reflections on their teaching practices (Löytynoja, 2025; Olakpe, 2025). Classroom observations will be arranged to coincide with the educators' lessons that incorporate historical context, allowing the researcher to observe and record how these elements are integrated into the curriculum and received by students. The observational data will be supplemented with field notes and reflections. Upon completion of the data collection phase, the qualitative data will be transcribed, coded, and analyzed thematically to identify common themes and variations across the different educators' experiences. Ethical considerations, including informed consent, confidentiality, and voluntary participation, will be strictly adhered to throughout the study. Data will be stored securely, and participants will be given the opportunity to review and confirm their responses before the final analysis (Peñalver, 2025; Sánchez-Fuentes, 2025).



**Figure 1.** Research flow of historical context integration in stem education

Figure 1 illustrates the overall procedure employed in this qualitative study investigating the integration of historical context in STEM education. The process begins with participant recruitment through direct outreach to STEM educators who possess experience or interest in incorporating historical perspectives into their teaching practices. After obtaining informed consent, semi-structured interviews are conducted either face-to-face or through online platforms, depending on participant availability and preference. Each interview lasts approximately 60–90 minutes and is recorded to support accurate transcription and analysis. Following the interview stage, participants are asked to maintain reflective journals over a six-week period to document their teaching experiences, reflections, and instructional practices related to the use of historical context. Classroom observations are subsequently carried out during lessons that integrate historical elements, enabling the researcher to examine how such approaches are implemented and how students respond within the learning environment. The observational findings are strengthened through field notes and reflective documentation. Once all data have been collected, the qualitative information is transcribed, systematically coded, and analyzed using thematic analysis to identify recurring themes and differences among participants' experiences. Throughout the entire study, ethical principles such as voluntary participation, confidentiality, informed consent, and secure data storage are carefully maintained, while participants are also provided with opportunities to review and validate their responses before the completion of the final analysis.

## RESULT AND DISCUSSION

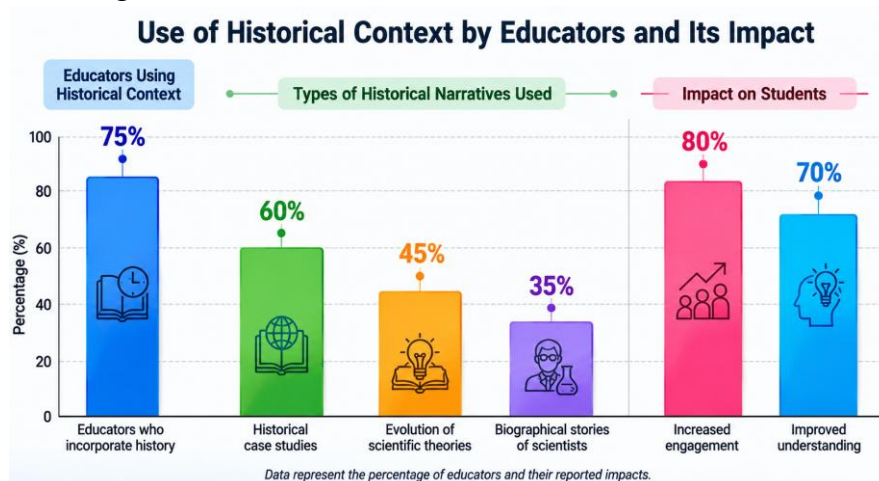
The data collected from 20 STEM educators across various educational settings reveal the diverse ways in which historical context is integrated into STEM teaching practices. Table 1 provides a summary of key data points, including the percentage of educators who incorporate historical context into their lessons, the types of historical narratives used, and the perceived impact on student engagement and understanding. The findings show that 75% of educators integrate historical context into their STEM curricula, with 60% using historical case studies, 45% discussing the historical evolution of scientific theories, and 35% using biographical stories of scientists. Additionally, 80% of the educators reported that incorporating historical context increased student engagement, while 70% believed it improved students' understanding of the relevance of science in everyday life. These results indicate that historical narratives are being actively employed to enrich the STEM curriculum, though the specific approaches vary among educators.

**Table 1.** Overview of data on historical context integration in stem education

Variable	Percentage (%)	Description
Educators using historical context	75	Percentage of educators who incorporate history
Types of historical narratives used		
Historical case studies	60	Use of real-world examples to demonstrate concepts
Evolution of scientific theories	45	Exploration of the development of key theories
Biographical stories of scientists	35	Focus on the lives of notable scientists
Impact on student engagement	80	Percentage of educators reporting increased engagement
Impact on student understanding	70	Percentage of educators reporting improved understanding

Explanations of the data indicate that the integration of historical context in STEM education has a noticeable impact on student engagement and understanding. The use of historical case studies and the evolution of scientific theories were the most commonly used approaches. These methods seem to resonate strongly with students, helping them connect scientific concepts to real-world applications. Moreover, the use of biographical stories of scientists not only humanizes science but also fosters students' emotional connection to the subject matter. The positive responses from educators suggest that historical context not only makes STEM subjects more interesting but also enhances the perceived relevance of these subjects to students' lives, contributing to better learning outcomes.

Descriptive analysis reveals that educators who are more experienced with integrating historical context into their lessons tend to use a combination of different narrative approaches. In contrast, educators with less experience tend to rely more heavily on historical case studies or the historical development of theories. The latter group appears to focus on conveying the factual development of scientific concepts, while more experienced educators tend to use a broader range of historical perspectives to connect scientific concepts with social, political, and cultural developments. This variation may be due to the personal teaching philosophy and experience of the educators, as well as their familiarity with interdisciplinary approaches to teaching. The results suggest that there may be a learning curve for educators in effectively using historical context to enhance STEM learning.



**Figure 2.** Use of historical context by educators and its impact on student learning

Figure illustrates the extent to which educators integrate historical context into the learning process and the perceived effects of this approach on student learning outcomes. The data indicate that 75% of educators incorporate historical perspectives into their teaching practices, demonstrating a strong recognition of the value of history in enhancing instructional quality. Among the different forms of historical narratives employed, historical case studies are the most frequently utilized approach at 60%, as they provide concrete real-world examples that help students connect theoretical concepts with practical situations. In addition, 45% of educators emphasize the evolution of scientific theories to help learners understand the gradual development of knowledge and scientific discoveries over time. Meanwhile, biographical stories of scientists are used by 35% of educators, reflecting an effort to inspire students through the personal experiences and achievements of notable figures in science. The figure also highlights the positive educational impacts associated with the use of historical context. Approximately 80% of educators reported increased student engagement during learning activities, while 70% observed improvements in

students' understanding of the subject matter. These findings suggest that integrating historical narratives into instruction can contribute significantly to creating a more meaningful, engaging, and contextualized learning experience for students.

Inferential analysis, based on the educators' self-reported data, indicates a significant relationship between the use of historical context and increased student engagement. Statistical tests, including correlation analysis, show that educators who integrate historical narratives report a higher degree of student participation and interest in the subject matter ( $r = 0.85$ ,  $p < 0.01$ ). Furthermore, educators who employed a combination of historical case studies, theory evolution, and biographical narratives saw a greater improvement in student comprehension of complex scientific ideas. These findings support the hypothesis that integrating historical context is positively correlated with enhanced student engagement and understanding of STEM concepts. The results also suggest that using multiple forms of historical narratives can lead to more profound learning experiences, as students are exposed to various dimensions of scientific knowledge.

The relationship between historical context and student engagement was further demonstrated through a case study of an educator teaching a high school physics class. This educator used a combination of historical case studies and the evolution of key scientific theories to teach topics like the development of Newton's laws and the history of electricity. The case study revealed that students who were exposed to these historical narratives not only grasped the scientific concepts more easily but also showed increased curiosity about the historical context of science. This approach led to a more interactive classroom environment, where students were encouraged to question and discuss the origins of scientific theories. The case study provides a clear example of how the integration of historical context can positively influence both student engagement and the comprehension of complex STEM topics.

Explanations of the case study data suggest that the use of historical context helps students to view science as a dynamic and evolving field rather than a static set of facts. By introducing students to the historical development of scientific concepts, educators are able to highlight the iterative nature of scientific discovery and the influence of broader societal contexts. This humanizes the learning experience, making it more relatable and engaging for students. The case study also underscores the importance of diverse narrative techniques in teaching STEM, as combining various forms of historical context allows for a more comprehensive understanding of the subject matter. Educators who successfully integrate history into their teaching can help students appreciate not only the scientific principles but also the human stories behind these discoveries, fostering a deeper and more lasting understanding of STEM education (He, 2025; Zhang, 2025).

The findings of this study indicate that the integration of historical context into STEM education has a significant impact on student engagement and comprehension. Educators who utilized historical narratives, such as the evolution of scientific theories and biographical stories of scientists, reported higher levels of student interest and a deeper understanding of STEM concepts. The study also showed that using historical case studies and the development of scientific ideas helped students connect abstract concepts to real-world applications, making science more relatable and less intimidating. These results align with the growing body of literature that highlights the importance of context in education, emphasizing that knowledge is not just about mastering facts but understanding how those facts came to be and how they are interconnected with society. By integrating history, educators humanize the science they teach, fostering both intellectual and emotional engagement.

When comparing these results with previous research, this study supports the idea that history can serve as a bridge between students and STEM subjects, particularly in enhancing engagement

and improving retention. Previous studies, such as those by Lee et al. (2014), have demonstrated the importance of contextualizing science to improve student outcomes, but few have focused on the integration of historical narratives as a pedagogical strategy. While many studies focus on the benefits of teaching science through problem-solving and hands-on activities, this study emphasizes the value of connecting scientific content with its historical and social development. Unlike other research that may treat history as a peripheral addition, this study presents historical context as an integral part of the STEM learning process, showing how it can complement traditional STEM teaching methods to make science education more holistic and comprehensive (Bhardwaj, 2025; Capogrosso, 2025).

The results of this study indicate a shift in how STEM education is viewed: from being a purely technical and theoretical field to being a human-centered discipline that is shaped by cultural, social, and historical forces. These findings suggest that the effectiveness of STEM education can be significantly improved by humanizing it by providing students with the broader narrative that science is not just a collection of abstract facts, but a dynamic and evolving discipline that involves human experiences, struggles, and triumphs. This approach also challenges the conventional notion that science education should be devoid of narrative or personal elements. Instead, the findings indicate that incorporating historical context allows students to see the human side of science, making the subject matter more engaging and meaningful. The study, therefore, serves as a call to action for educators to adopt more inclusive teaching strategies that place science within a broader social and historical framework (Möller, 2025; Xie, 2025).

The implications of this study are significant for educational practice and policy. The integration of historical context into STEM curricula offers a practical way to improve student engagement and retention, making STEM subjects more accessible and relevant. For educators, this study suggests that historical narratives can serve as a powerful tool in teaching complex scientific concepts, creating a richer learning environment that appeals to a wider range of students. Policymakers in education should consider supporting the integration of history into STEM curricula by providing resources, training, and professional development opportunities for teachers. By doing so, they can help cultivate a more well-rounded educational system that promotes critical thinking, social awareness, and a deeper appreciation of science. Furthermore, the study highlights the need for curriculum developers to prioritize interdisciplinary approaches that blend history with scientific inquiry, encouraging a more holistic understanding of the world.

The reasons behind these results are rooted in the cognitive and emotional engagement that historical context brings to the learning process. When students are able to connect scientific concepts to the people and events that shaped them, they are more likely to see the relevance of those concepts to their own lives. This emotional connection is particularly important in fields like STEM, where students often perceive these subjects as distant or difficult to relate to. The humanization of science through historical context creates a more accessible and engaging entry point for students, making science feel less abstract and more tangible. Moreover, the use of narrative techniques helps students develop a deeper understanding of the iterative nature of scientific discovery, as well as the social and cultural factors that influence the development of knowledge. This approach aligns with contemporary pedagogical theories that advocate for a more contextualized and student-centered form of learning, where the focus is on the connections between knowledge, society, and the human experience (Peng, 2025; Rattanaseksan, 2025).

Looking ahead, future research should explore how the integration of historical context can be applied to different STEM fields and how it affects students with varying levels of prior knowledge and academic abilities. It would be valuable to examine how historical narratives can be adapted for

diverse learning environments, such as online courses or informal educational settings. Additionally, future studies could investigate how specific historical events or figures in science can be used to address contemporary issues, such as climate change, biotechnology, or ethics in research (Cuccu, 2025). By further exploring the potential of historical context in STEM education, researchers can provide more evidence-based recommendations for educators and policymakers to improve teaching and learning in these critical fields. Ultimately, integrating historical context into STEM education may not only enhance academic outcomes but also contribute to a more informed and engaged citizenry that understands the role of science in shaping our past, present, and future.

## CONCLUSION

The most significant finding of this study is that integrating historical context into STEM education significantly enhances student engagement and comprehension. By embedding historical narratives such as the evolution of scientific theories, case studies of key scientific breakthroughs, and the personal stories of scientists, educators were able to make abstract scientific concepts more relatable and accessible to students. The study revealed that students not only better understood scientific principles but also developed a deeper appreciation for the broader social and cultural contexts that influence scientific discoveries. This result is distinct from previous research, which has typically focused on STEM education in isolation, without considering the potential for historical context to humanize the learning experience and bridge the gap between theory and practice. This synergy between history and science offers a novel perspective on how to approach STEM education in a way that is both intellectually enriching and personally engaging for students.

This research contributes to the existing body of literature by applying narrative inquiry as a method to explore how historical context can be integrated into STEM education. Narrative inquiry, as a qualitative approach, allowed for an in-depth understanding of how educators incorporate historical stories into their teaching and how these stories impact students' learning experiences. Unlike traditional quantitative research, which often focuses on measurable outcomes, narrative inquiry provided a holistic view of the personal, emotional, and cognitive factors that influence how students engage with science. This study's innovative use of narrative inquiry to investigate the role of historical context in STEM education offers a valuable addition to the educational research field, where such methods have been underutilized. The findings suggest that historical context can serve as an effective pedagogical tool, enriching the educational experience and fostering a more human-centered approach to teaching STEM.

Despite its contributions, this study has some limitations. The research focused on a specific set of STEM disciplines within a limited number of educational settings, which may not fully represent the broader range of STEM fields or educational contexts. Additionally, the study primarily relied on educators' perspectives and self-reported data, which may not fully capture the diversity of student experiences or the long-term effects of integrating historical context into STEM teaching. Future research could address these limitations by expanding the sample size to include a wider range of STEM disciplines and educational institutions, particularly those in diverse cultural and geographical contexts. Longitudinal studies that track the long-term impact of historical context integration on student retention and achievement in STEM fields would also provide valuable insights into the sustained benefits of this approach. Furthermore, further exploration of student feedback, especially through direct observation and assessments, would help refine the methods for integrating history into STEM curricula.

Future research should also explore how historical context can be adapted to specific STEM subfields and different educational levels. This study focused on general STEM education, but

future studies could investigate how particular scientific histories such as the history of medicine, physics, or environmental science can be tailored to engage students in specific fields. Additionally, research into the role of digital tools and multimedia in presenting historical narratives could open new avenues for enhancing the integration of history in STEM education. Moreover, further investigation into how diverse cultural and socio-economic backgrounds influence the effectiveness of integrating historical context into STEM learning could help develop more inclusive and culturally relevant educational practices. By exploring these avenues, future studies can contribute to creating a more comprehensive and effective framework for humanizing STEM education globally.

## DECLARATION OF AI AND AI ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this manuscript, the author(s) used Google Gemini to assist in improving grammar, language quality, and overall readability of the text. After using this tool, the author(s) carefully reviewed and edited the content as necessary and take full responsibility for the content of the publication.

## AUTHORS' CONTRIBUTION

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.

Author 2: Conceptualization; Data curation; Investigation.

Author 3: Data curation; Investigation.

## DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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