From Madeira to Hawaii: Augmented Reality Enhancing Creative Historical Education

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Abstract
The project 'From Madeira to Hawaii' stands as an innovative educational initiative that has stimulated creativity and historical research among students. It explores the late 19th-century migrations from Madeira Island to Hawaii. Grounded in the principles of Action Research (Elliott, 1991), the pedagogical process culminated in the creation of an Augmented Reality (AR)-enhanced comic book. This achievement represents a collaborative effort between students and published illustrators from Madeira Island, who seamlessly merged in-depth research, creative illustrations, and AR elements to bring historical narratives to life. Participants explored Madeira and Hawaii's 19th-century art and culture, enriching the AR publication with vibrant artistic and historical elements. This fusion stimulated creativity and fostered a comprehensive understanding of the historical context of the migratory journey. The project employed an interdisciplinary approach, echoing Philippe Meirieu's emphasis on active learning, blending history, art education, and technology. Through active participation, students enhanced their critical thinking, problem-solving, and collaboration skills, transcending traditional learning methods and embarking on an immersive, dynamic historical exploration beyond the classroom. This presentation aims to critically analyze the construction of the comic book and the pedagogical process undertaken. The project fostered a deeper appreciation for history, art, and technology among students, as evidenced by their increased curiosity and the independent pursuit of further historical research. As a testament to AR's transformative potential, 'From Madeira to Hawaii' represents a significant stride in nurturing creativity and innovation, harmoniously integrating technology with history and art education.

Keywords: Augmented Reality Education, Historical Research, Interdisciplinary Learning, Madeira

Introduction

Education plays a crucial role in shaping societies and creating well-informed citizens who can analyze, question, and transform the world around them. However, with the increasing pace of digitalization and globalization, education needs to adapt and evolve to meet the changing needs and expectations of new generations. This article delves into a fascinating educational project that combines three seemingly unrelated elements: comics, history, and Augmented Reality (AR). By bringing together these diverse elements, this innovative educational project creates a truly immersive and enriching learning experience that goes beyond the traditional limitations of education. Through its unique approach, this educational project helps students to understand history better by experiencing it in an entirely new way, making learning not only more engaging but also more effective.

The Transformative Power of Education

Education is a transformative process (Freire, 1970) that can change people's lives and shape their futures. Throughout history, it has transmitted knowledge, values, and culture from one generation to another. However, in the current era, education faces unique challenges and opportunities. The increasing digitalization, globalization, and rapid technological evolution are reshaping how we learn and teach.

In this context, it is imperative for education to embrace innovation and constant adaptation. Educators and educational program designers must explore new ways to engage students, spark their curiosity, and prepare them for a constantly changing world. One of the most promising approaches is the combination of traditional media with cutting-edge technology to create meaningful and effective learning experiences.

The Convergence of Educational Elements

This educational project is based on the convergence of three seemingly disparate elements: comics, history, and Augmented Reality (AR). Each of these elements plays a fundamental role in creating a unique and enriching learning experience.

Storytelling has been a powerful tool for knowledge transmission and connection between generations throughout history. In the contemporary era, education has evolved significantly, adopting innovative pedagogical approaches and emerging technologies to engage students in new and exciting ways. One approach that has gained attention is the combination of comics and AR technology as a learning vehicle. In this article, we explore how the educational project "From Madeira to Hawaii" merges these elements to create a unique and effective pedagogical experience.

The Power of Comics

Comics have been a medium of communication and artistic expression for generations. Their ability to tell stories through visual and narrative means has made them highly effective in engaging readers of all ages. Through juxtaposed panels and the intelligent use of images and words, comics can convey emotions, impart complex information, and stimulate the imagination uniquely.

Comics are not limited to fictional narratives; they can also address historical, social, and cultural topics in an accessible and engaging manner. Educators have recognized their value as an effective pedagogical tool to engage students and foster an understanding of complex concepts. In this project, the comic becomes the gateway to exploring the history of migration from Madeira to Hawaii.

Scott McCloud (1994), in his influential work "Understanding Comics," describes comics as a form of visual communication that uses sequential images to convey information and emotions. He defines comics as a series of illustrations in a deliberate sequence intended to convey information and/or produce an aesthetic response in the viewer. This definition underscores the unique capacity of comics to blend visual and narrative elements.

The significance of comics in education lies in their ability to communicate effectively and engagingly. McCloud argues that comics invite readers to fill in the gaps between panels with their imagination, creating a participatory experience. This active engagement is crucial for the learning process, as it involves both the intellect and emotion.

Comics can simplify complex concepts, narrate historical and scientific stories, and promote literacy. However, integrating Augmented Reality technology elevates this educational experience.

Augmented Reality overlays digital elements onto the real world, enriching comics with interactive components like videos, 3D objects, and additional content, creating a multisensory learning experience that appeals to students of all learning styles.

The project "From Madeira to Hawaii" leverages the synergy between comics and AR to offer a unique educational experience. Through comics and AR technology, students explore historical and cultural events in an immersive environment, promising to convey knowledge and ignite curiosity, creativity, and a love for learning.

The Importance of History

History forms the foundation of our understanding of the world around us (Freire, 1970). Knowing and understanding history is crucial for comprehending our current state and how past actions have shaped the present and future (Meirieu, 2010). However, history is often presented in a boring and decontextualized manner in traditional educational settings.

This project aims to recover a significant, yet often overlooked, part of history: the 19th-century migration from the Island of Madeira to the Hawaiian Islands. Despite its relevance, this story has largely remained unnoticed. By bringing this historical narrative to life, the goal is to inform students about the events and individuals involved and to connect them with their cultural and familial heritage.

The Augmented Reality Revolution

Augmented Reality (AR) is a technology that has revolutionized how we interact with the digital and physical worlds. AR combines real-world elements with virtual components, creating immersive and interactive hybrid experiences. Modern devices, such as mobile phones and AR glasses, allow users to see digital information overlaid on their real environment.

In the educational context, AR opens a vast field of possibilities. It enables the creation of interactive educational experiences that extend beyond textbook pages or classroom walls. Students can "touch" history, explore abstract concepts in tangible ways, and actively engage in their learning process.

In this project, AR serves as a bridge between the comic and history. This technology adds an additional layer of depth and understanding to the historical narrative presented in the comic "From Madeira to Hawaii." Readers can scan specific comic pages with their mobile devices, bringing illustrations to life. This reveals additional information, historical reconstructions, and three-dimensional objects that enrich the reading experience.

The Project Context

This educational project was developed as part of the INTERREG Atlantic TIDE project: Atlantic Network for the Development of Historical Maritime Tourism. The main objective of this project was to support organizations in the Atlantic region in identifying potential niche tourism packages in these areas. Through the initiatives supported by TIDE, Virtual Reality (VR) and Augmented Reality (AR) technologies were used in the fields of history, archaeology, and underwater exploration to enrich visitors' experiences and add a new dimension to the cultural heritage in these areas.

The "From Madeira to Hawaii" project aligns with this mission by highlighting the migratory journey of people from the Island of Madeira to the Hawaiian Islands in the late 19th century. This historical migration was significant not only to the Madeira archipelago but also left a lasting impact on the Hawaiian archipelago, where the influence of this group of migrants is still evident in certain religious, musical, and culinary traditions.

Project Objectives

The objectives of this educational project are multiple and ambitious, addressing both education and the preservation of cultural heritage. Through the combination of comics, history, and Augmented Reality (AR), it seeks to achieve the following objectives:

> **Rescue a Forgotten History:** A fundamental objective is to unearth and highlight a significant part of history that has largely been overlooked. The migration of people from the Island of Madeira to Hawaii in the late 19th century to work on sugar cane plantations represents a historically significant episode often omitted in traditional education. By revitalizing this narrative, the aim is to educate new generations about the events and individuals involved in this migration.
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> **Connect With Cultural Heritage:** The migration from Madeira to Hawaii is more than a story distant in time and space; it is part of the cultural heritage of people in both regions. This project endeavors to connect students and readers with their cultural and familial heritage, encouraging them to explore their family genealogies and understand the religious, cultural, and social history they inherit.
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> **Promote Historical Intelligence:** In line with Meirieu (2010), this project aims to develop students' historical intelligence, encouraging young people to explore their cultural heritage, understand their origins, and how that history shapes their identity and perspectives. Education extends beyond developing formal intelligence to

cultivating historical intelligence, enabling individuals to locate themselves within the human collective with knowledge and insight.

Use Comics as and Educational Vehicle: Comics serve as a fundamental educational vehicle in this project. As McCloud (1994) notes, comics are an art form that combines sequential illustrations to convey information and evoke aesthetic responses in the reader. With their visual and narrative nature, comics are especially appealing to young readers and can communicate information in an accessible and engaging manner.

Leverage Augmented Reality Technology: AR technology is employed as a potent tool to enhance the educational experience. Beyond narrating the story through comics, AR adds an additional layer by enabling readers to interactively explore historical reconstructions, three-dimensional objects, and other pertinent information, immersing students in the history and culture of their region through engaging and participatory experiences.

Engage Students in Creation: A unique aspect of this project is the active participation of students in its creation. The primary creators are students, young people, and teenagers eager to contribute to a tangible project that goes beyond the classroom. They are motivated to assume roles of responsibility and engage in every project phase, from historical research to the development of AR content, providing a hands-on and significant learning experience.

Integrate Constructivist Learning: The project is founded on Vygotsky's (1978) concept of the zone of proximal development, which highlights the gap between what learners can achieve independently and with a more experienced mentor's guidance. This approach allows students to learn by collaborating with experienced comic authors, acquiring new skills and insights they could not have developed alone.

Promote Digital Literacy: In our increasingly digital era, digital literacy is an essential skill. This project gives students the opportunity to engage with AR technology, enriching their historical understanding and acquainting them with digital tools and concepts, crucial in a world where technology is integral to nearly all life aspects.

Reach Diverse Audiences: The project aims to reach diverse and global audiences. Besides the Portuguese version, an English version of the comic was created to allow readers in Hawaii to engage with this shared story, facilitated by contacts with the Honorary Consul of Portugal in Hawaii. This broadens the project's impact and fosters intercultural understanding.

Project Methodology

The methodology used in this educational project was based on a combination of pedagogical approaches ranging from constructivist education (Papert, 1993; Vygotsky, 1978) to the integration of cutting-edge educational technology. The choice of methodologies aimed at achieving deep and meaningful learning in students while fostering collaboration and active participation.

Constructivist Approach: Influenced by theorists such as Seymour Papert and Lev Vygotsky, the constructivist approach was fundamental to this project's design. This approach views students not as passive recipients of knowledge but as active constructors of their understanding, focusing on meaning-building through interaction with content and collaboration.

In this project, students were active learners and knowledge creators. They went beyond merely consuming information about the migration from Madeira to Hawaii and actively participated in research, storytelling, and content creation.

Interdisciplinary Collaboration: The project facilitated interdisciplinary collaboration by uniting students from different fields—history, art, and technology—with experienced comic artists. This diverse collaboration enriched the creative process and enabled a comprehensive understanding of the story, allowing students to learn about the migration from historical, artistic, and technological perspectives. Collaborating with comic artists offered insights into visual storytelling and artistic representation.

Vygotsky's Zone of Proximal Development: Based on Lev Vygotsky's (1978) Zone of Proximal Development theory, which highlights the difference between what learners can do independently versus with a mentor's help, this project saw students benefiting from this concept. By working alongside experienced comic authors Valter de Sousa and Samuel Jarimba, and mediated by the course teacher, students improved their skills and gained insights into professional creative processes, from plot development to character design and panel sequencing.

Augmented Reality Technology as an Educational Tool: Augmented Reality (AR) technology was implemented using web-based platforms, providing a technological framework to animate the comic's historical narrative and enhance the learning experience.

These accessible platforms enabled the integration of AR elements into the comic, offering interactive experiences. For instance, readers could scan panels with mobile devices to unlock three-dimensional historical recreations or listen to audio files of significant events.

The creation of QR codes linked to AR content facilitated easy access for any reader with a mobile device and internet connection, ensuring technology did not hinder student engagement. The inclusion of 3D objects allowed for exploration of historical artifacts from various angles, such as examining traditional musical instruments related to the migration in detail, enriching story comprehension and stimulating curiosity.

Communication and Collaboration Through Technology: Communication and collaboration were pivotal in this project, involving students, comic artists, teachers, and other collaborators. To ensure fluid and effective communication, a WhatsApp group was established, and a cloud platform was utilized for sharing and coordinating the project's progress. This setup allowed each contributor to post and view the work being developed by the team in real-time. Technology thus facilitated collaboration,

bridging the physical distance between participants, including comic artists working from remote locations.

In summary, the methodology of this educational project was grounded in constructivist learning, interdisciplinary collaboration, the integration of Augmented Reality, and the application of Vygotsky's Zone of Proximal Development theory (1978). These methodologies were synergistically employed to offer students a meaningful and enriching learning experience, enhancing historical understanding, digital literacy, and creative collaboration (Eisner, 2004).

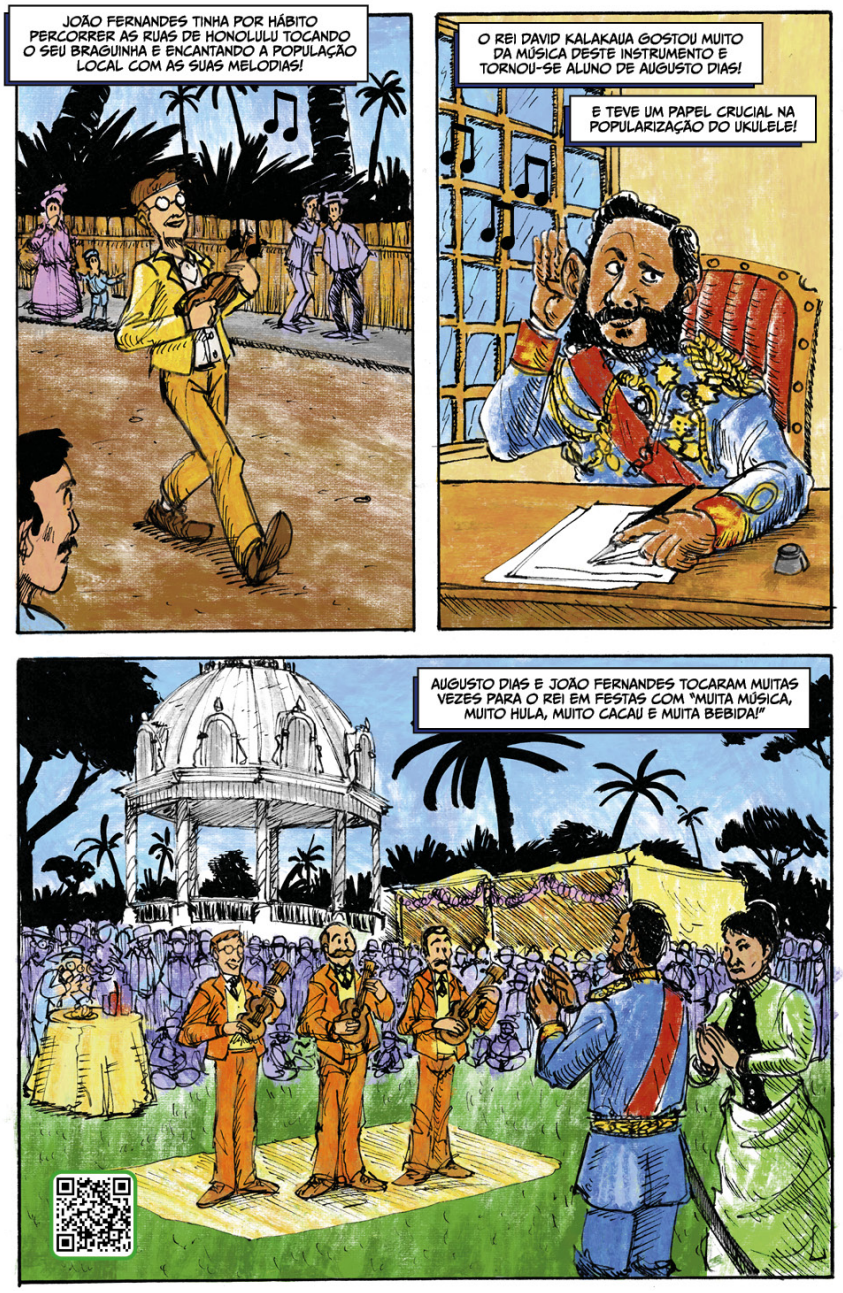

Figure 1: Page from the Portuguese edition of the comic "From Madeira to Hawaii" with a QR code that activates Augmented Reality content virtually superimposed over the printed image.

Project Results

The results of this educational project have been significant and manifested in the enhanced understanding of history among students. Delving into the 19th-century migration from Madeira to Hawaii, they have acquired a detailed knowledge of the events, motivations, and consequences of this historical phenomenon, exploring the lives and experiences of individuals involved in the migration.

Personal Connection With Cultural Heritage: The project has enabled students to establish a personal connection with their cultural heritage, particularly for those with roots in Madeira. Discovering stories of their ancestors has strengthened their cultural identity and sense of belonging to a broader community, highlighting the importance of preserving and sharing these stories with future generations.

Development of Research Skills: Historical research was fundamental in creating the comic and Augmented Reality experiences. Students utilized libraries, regional archives, and online resources to gather information about the migration, thereby honing their research skills, including source evaluation and information synthesis, valuable across educational and professional contexts.

Active Participation in Creation: Students actively participated in every creation stage, contributing to the narrative, illustrations, Augmented Reality designs, and decision-making processes. This engagement fostered a sense of agency and ownership over the project, enhancing their motivation (Silva & Fraga, 2022; Polli & Fraga, 2022).

Immersive Augmented Reality Experiences: Augmented Reality experiences have deepened historical understanding by offering interactive exploration of historical reconstructions and three-dimensional objects, sparking curiosity, and encouraging further exploration of the narrative (Eisner, 2004).

Promotion of Digital Literacy: The project has enhanced students' digital literacy through interaction with Augmented Reality technology, equipping them with digital skills essential for navigating the technological landscape of the 21st century (UNESCO, 2022).

Global Reach: The creation of an English version of the comic expanded the project's reach, attracting readers in Hawaii and globally through both print and free digital e-book distributions. This effort has fostered intercultural understanding and enriched the educational experience.

Impact on Students

One of this project's most notable aspects is its positive impact on students. Engaging in research, comic creation, and the implementation of Augmented Reality, they experienced significant growth in several areas:

Historical Understanding: The project achieved its goal of enhancing students' historical understanding. Participants learned about the migration from Madeira to Hawaii through research and comic creation. They developed a deeper appreciation of

the reasons behind these movements and their impact on both regions. This became a testament to the power of experiential learning.

Cultural Identity: Exploring their cultural and familial roots was an enlightening experience for the students. As they researched the history of their ancestors and their role in the migration, they began to question their own genealogy and cultural heritage (Meirieu, 2010). This self-discovery contributed to a greater awareness of themselves and their place in society (Freire, 1970).

Creative Skills: Collaborating with comic artists and creating visual content enriched the students' creative skills. They learned to bring characters and settings to life through art, which has applications in fields beyond storytelling, such as graphic design and illustration.

Technological Skills: Incorporating Augmented Reality not only enriched the learning experience but also improved students' technological skills. They learned to create Augmented Reality content and use digital tools to tell stories in innovative ways.

Curiosity and Continuous Learning: The project sparked students' curiosity and encouraged continuous learning. Research became an exciting endeavor, with many students continuing to explore the history of Madeira and Hawaii even after the project concluded.

Contribution to Contemporary Education

This project exemplifies how contemporary education can benefit from the integration of advanced technologies and innovative pedagogical approaches. Key aspects demonstrating its contribution to modern education include:

Project-Based Learning: The project adopted a project-based learning approach (Dewey, 1916), proving to be an effective methodology for engaging students in active and meaningful learning. Projects like this foster research, collaboration, and problem-solving.

Interdisciplinarity: The interdisciplinary collaboration among students from various fields, along with experienced comic artists, highlights the importance of interdisciplinarity in contemporary education. Real-world problems often necessitate a multidisciplinary approach, and this project equipped students to address complex challenges from diverse perspectives (Polli & Fraga, 2022).

Educational Technology: Incorporating Augmented Reality showcased how educational technology could make learning more engaging and relevant for students. Technology served not merely as a tool for storytelling but as an integral part of the learning process.

Promotion of Identity and Cultural Heritage: The project encouraged students to explore their cultural roots and understand how their ancestors' history influences their current identity (Meirieu, 2010). Such understanding is vital in an increasingly diverse and globalized world (UNESCO, 2022).

Limitations and Challenges

Despite its successes, this project faced limitations and challenges. A primary challenge was the need for technological resources, including modern mobile devices for accessing Augmented Reality. Not all students had access to these devices, leading to inequalities in the learning experience.

Moreover, integrating Augmented Reality technology required significant time and training, which sometimes posed a learning curve for participants. The availability of mobile devices and familiarity with technology varied among students, occasionally resulting in disparities in the learning experience.

Future Directions

This project lays the groundwork for future research and educational projects aiming to harness the power of digital storytelling, Augmented Reality, and project-based learning. Potential future directions include:

Exploration of Other Stories: Applying this project's methodology to explore other migratory and cultural narratives could enhance students' understanding of cultural diversity and global interconnections.

Development of Educational Resources: Comics enriched with Augmented Reality and other technologies could become valuable resources for classrooms worldwide. Developing additional educational materials using this approach is a promising avenue.

Teacher Training: Training educators in the effective use of educational technologies like Augmented Reality is crucial. Ensuring that more students can benefit from these innovations requires dedicated teacher training programs.

Conclusion

The educational project 'The comic "From Madeira to Hawaii": A pedagogical journey enhanced by Augmented Reality' has achieved its objectives of rescuing a forgotten history, connecting students with their cultural heritage, fostering historical intelligence, and employing comics and Augmented Reality as effective educational tools. It has demonstrated that education can be both meaningful and enriching when combined with technology and interdisciplinary collaboration.

This project has benefited not only the students directly involved in its creation but also a wider audience through the publication of the comic in both print and online formats. It has contributed to the development of digital literacy and promoted intercultural understanding.

In an increasingly digital and globalized world, this project underscores the importance of preserving and transmitting cultural stories and promoting meaningful education. By uniting history, art, and technology, it has created a powerful pedagogical resource that transcends traditional educational boundaries.

In summary, 'From Madeira to Hawaii' serves as an inspiring example of how education can be transformative when innovation is embraced and connected with history and culture. This project represents an innovative interdisciplinary approach that merges history, art education, and technology to create a comprehensive and meaningful learning experience. Comics and Augmented Reality emerge as powerful pedagogical tools, inspiring future generations to explore their cultural heritage and understand the world around them.

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