ISSN 1982-5587

Articles

Application of artificial intelligence in indigenous pedagogy: a case study in Basic Education[1]

Aplicação da Inteligência Artificial na pedagogia indígena: um estudo de caso em Educação Básica

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HOW TO CITE: FAUSTO, I. R. S; LETA, F. R.; BRAZ, R. M. M. **Application of artificial intelligence in indigenous pedagogy:** a case study in Basic Education. Revista Ibero-Americana de Estudos em Educação, Araraquara, v. 19, esp 3, e19321, 2024. e-ISSN: 1982-5587. DOI: https://doi.org/10.21723/riaee.v19i00.1932102

Abstract

This study investigates the application of AI tools by indigenous teachers in a continuing education course, emphasizing cultural appreciation and the development of digital competencies. The course adopted an interactive approach, with practical and dynamic sessions that actively involve the indigenous teachers. This allowed for the immediate application of the concepts learned in their own educational and cultural contexts, promoted by ethno-informatics. The course valued and strengthened indigenous culture, encouraging teachers to incorporate elements and symbolism from their traditions into the content and activities developed with the support of artificial intelligence.

Keywords: Artificial Intelligence; image creation; indigenous teachers; educational robotics.

Resumo

Este estudo investiga a aplicação de ferramentas de IA por professores indígenas em um curso de formação continuada, enfatizando a valorização cultural e o desenvolvimento de competências digitais. O curso adotou uma abordagem interativa, com sessões práticas e dinâmicas que envolvem ativamente os professores indígenas. Isso permitiu a aplicação imediata dos conceitos aprendidos em seus próprios contextos educacionais e culturais, promovidos pela etnoinformática. O curso valorizou e fortaleceu a cultura indígena, incentivando os professores a incorporar elementos e simbologias de suas tradições nos conteúdos e atividades desenvolvidos com o apoio da inteligência artificial.

Palavras-chave: Inteligência Artificial; Criação de imagens; professores indígenas; robótica educacional.

INTRODUCTION

Despite significant legal advances, indigenous education in Brazil still faces long-lasting challenges, including the marginalization and lack of recognition of their practices and traditions (Silva; Barbosa, 2018; Fausto; Leta; Braz, 2024a). This scenario highlights the urgent need to rethink educational models and integrate technological solutions that can empower indigenous teachers and expand access to knowledge (Amadeu; et.al., 2022).

In this context, this study aims to fill the existing gap in the literature on the integration of AI in indigenous education, offering a new perspective on digital inclusion (Mezzomo; Kawamoto; Wonsik, 2023). The objective is to understand how these teachers are exploring and applying

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Submitted: May 20, 2024
Reviewed: August 17, 2024
Approved: September 04, 2024
Financial support: Process No. 23243.005469/2022-00 – PROEX - IFRO
Conflicts of interest: There are no conflicts of interest.
Ethics committee approval: Opinion CAAE No. 66887723.0.0000.8160
Data Availability: Available for consultation at: https://virtual.ifro.edu.br/jiparana/local/pages/?id=4
Study conducted in the city of Ji-Paraná--RO

[1] The continuing education course in Computing, Technologies, and Educational Robotics for Basic Education was developed with financial and institutional support from of the **Distance Education Directorate (DEAD) of the Federal Institute of Rondônia (IFRO)**, to ensure the sustainability and scalability of the project, and allowing it to reach a significant number of indigenous teachers, in different regions of the country, as well as indigenous organizations. This close collaboration between various key stakeholders was essential to ensure the relevance, cultural appropriateness, and effectiveness of the teacher training programme.

these new tools in their pedagogical practices, focusing on the appreciation and preservation of indigenous culture and identity.

The course adopted an interactive approach, with practical and dynamic sessions that actively involve the indigenous teachers. This allowed for the immediate application of the concepts learned in their own educational and cultural contexts, promoted by ethno-informatics (Brasil, 2023a). The course valued and strengthened indigenous culture, encouraging teachers to incorporate elements and symbolism from their traditions into the content and activities developed with the support of artificial intelligence (Fundação Nacional do Índio, 2024).

Digital inclusion is a highly relevant topic in contemporary society, being considered a crucial factor for promoting equal opportunities and social inclusion (Amadeu; Silva; Manochio-Pina, 2022). Artificial Intelligence (AI), in turn, has proven to be a powerful tool for image creation and promoting digital inclusion (Neves; Fialho; Machado, 2021).

Education plays a fundamental role in promoting digital inclusion. Teaching AI in Basic Education is a new horizon for Brazilian research, and the implementation of AI in education presents several challenges (Bonilla; Pretto, 2011). However, integrating AI into education can bring several benefits, such as promoting digital inclusion and improving the quality of education (Bonilla; Pretto, 2011).

In the context of indigenous communities, digital inclusion can be a powerful tool for preserving and valuing their knowledge and cultures. The use of AI in image creation can allow these communities to express their worldviews in innovative and creative ways (Neves; Fialho; Machado, 2021).

POLICIES AND INITIATIVES FOR DIGITAL AND CULTURAL INCLUSION

- The digital and cultural inclusion of indigenous peoples involves policies and initiatives that require critical evaluation. In this context, some relevant actions are highlighted:
- **Universidade Paiter A Soeitxawe (Unipaiter):** Led by the Paiter Suruí (Povo Paiter Suruí, 2023) people, this project seeks to integrate cultural teachings and indigenous ways of life with scientific and technological research. Despite the challenges, Unipaiter prepares educators proficient in computational technologies and educational robotics.
- Increased Funding: This can provide resources to invest in educational technologies in indigenous schools. The creation of the Directorate of Indigenous School Education also facilitates the implementation of these technologies (Brasil, 2023b).
- National Policy of Ethnoeducational Territories (Brasil, 2009): Organises Indigenous School Education in specific geographical and cultural spaces, promoting meaningful and inclusive learning.
- Ethno-informatics: This approach combines traditional indigenous knowledge with information and communication technologies, being relevant for implementing educational technologies in indigenous contexts.
- United Nations Declaration on the Rights of Indigenous Peoples (Organização das Nações Unidas, 2008): Recognizes and affirms the fundamental rights of indigenous peoples, emphasizing the preservation of their cultures and the right to education. The effectiveness of these policies depends on their implementation, the involvement of indigenous communities, and the socio-political context.

CHALLENGES AND STRATEGIES IN INDIGENOUS TEACHER TRAINING

The training of indigenous teachers is a complex and unique area, with specific challenges and perspectives. According to Brasil (2002):

> (...) The indigenous school has as its basic element of definition its location, in lands inhabited by indigenous communities, the exclusivity of its service to the indigenous population, the teaching provided in the mother tongues and second languages of the communities served, and its own curricular organization. (Brasil, 2002, p. 15).

Freire (1987) refers to the education of indigenous peoples:

> In this society without school, where there were no exclusively pedagogical social situations, the transmission of knowledge was done in everyday exchange, through personal and direct contacts. Learning took place at all times and in any place. In the division of labor, there was no specialist - the teacher - dissociated from the material conditions of the group's existence. Since it was always possible to learn something in any type of social relationship, this made any individual an agent of tribal education, keeping alive the principle that everyone educates. (Freire, 1987, p. 15).

The training of indigenous teachers is crucial to ensure the quality of education in indigenous communities. Various authors have contributed to this discussion: Devesa and Bonifácio (2021) highlights the critical importance of ensuring the right to indigenous teacher training, emphasizing the need for differentiated education and adequate pedagogical conditions in communities Guimarães et al. (2023) complements this view, stressing the relevance of specific government policies for the training of these educators.

We also observe the analysis of the evolution of indigenous teacher training in the State of Tocantins, as presented by Freire (2023), highlighting public policies, specific courses, and proposals that aim to articulate teacher qualification with the appreciation of indigenous culture (Cunha; Souza; Lazarotto, 2023) emphasizes the importance of reading in the training of indigenous teachers, highlighting the importance of methods that value the cultural production and literature of indigenous peoples.

Pontes Soares (2021) provides an analysis of pedagogical practices in Manaus, focusing on the Indigenous Teacher Training Programme (PROIND) mediated by IPTV technology. The study exemplifies how technology can strengthen culture and promote the schooling of indigenous students when contextualized and aligned with the specific needs of the communities.

Mendes (2022) proposes a reflection on decolonial thinking in indigenous teacher training courses, highlighting the importance of more significant indigenous representation in academic production.

Law 14.533, of 11 January 2023 (Brasil, 2023b), which establishes the National Digital Education Policy (PNED), emerges as a legal framework that supports the training of indigenous teachers in the use of digital technologies. However, it is imperative to contextualize this training within the scope of indigenous communities, considering the linguistic, cultural, and historical diversity of these groups.

The difference in the training of indigenous teachers, compared to conventional practices in non-indigenous contexts, is evident. The pedagogical approach must be sensitive to cultural traditions, their native tongue, and the way of life of indigenous communities (Brasil, 2002).

The appreciation of situated knowledge, as proposed by Freire (1987) and Wenger-Trayner and Wenger-Trayner (2015), is a fundamental strategy in the training of indigenous teachers. Integrating local knowledge provides a conducive environment to the exchange of experiences between educators and the community. Additionally, creating culturally relevant teaching materials, considering linguistic and cultural diversity, is crucial for an inclusive approach.

The training of indigenous teachers in the use of educational technologies is a relevant and challenging topic. Almeida (2022) reflects on the training process, especially in the context of the Indigenous Intercultural Pedagogy Course. These authors highlight the challenges and perspectives faced in this process, providing insights that can guide the implementation of computational technologies and educational robotics. These authors highlight the challenges and perspectives faced in this process, providing insights that can guide the implementation of computational technologies and educational robotics.

Furthermore, Gilberto (2009) discusses the training of indigenous teachers and indigenous education in Brazil, emphasizing the importance of the 1988 Brazilian Federal Constitution (Brasil, 1988) in guaranteeing basic education for indigenous people, respecting their cultural values. The document also addresses specific projects from the 1990s and the creation of indigenous schools.

Souza, Bettiol and Mubarac Sobrinho (2022), considering the curriculum of the Intercultural Indigenous Pedagogy Course, explores how the inclusion of educational technologies can be aligned with the intercultural approach, respecting and incorporating the cultural diversity of indigenous communities. The discussion on educational policies and the constitutional guarantee of basic education for indigenous people provides a relevant legal context for implementing digital technologies.

In summary, the training of indigenous teachers must be contextualized, sensitive to the cultural and linguistic specificities of the communities. Strategies that value situated knowledge and promote the active participation of indigenous educators are essential. Collaboration with communities, whilst respecting their autonomy, is fundamental for authentic and inclusive pedagogical practice. This approach aims to contribute to meaningful education aligned with the cultural and linguistic identities of indigenous communities.

This thematic continuum establishes a crucial connection, allowing a comprehensive view of the insertion of educational technologies in the unique context of indigenous teacher training, intending to promote inclusive and meaningful education.

CHALLENGES AND OPPORTUNITIES OF TECHNOLOGICAL INTEGRATION

The integration of technologies in the training of indigenous teachers is a relevant topic in the contemporary educational scenario. Authors such as Alves, Bueno and Amaral (2015) highlight the need to consider the intercultural perspective and the integration of Information and Communication Technologies (ICT) in this context. Bento (2023) points out the challenges faced by indigenous teachers in incorporating ICT into their teaching practices.

The documents: the Curricular Reference for Indigenous Schools (Brasil, 1998) and the "References for the Training of Indigenous Teachers" (Brasil, 2002), prepared by the Ministry of Education, emphasize the importance of strengthening the sociocultural practices and the mother tongue of each indigenous community, developing specific curricula and programs, as well as systematically preparing and publishing specific and differentiated teaching material. These guidelines reinforce the need for.

These guidelines reinforce the need for a sensitive and contextualized approach in the training of indigenous teachers, incorporating technologies to promote more inclusive education aligned with local realities. These guidelines reinforce the need for a sensitive and contextualized approach in the training of indigenous teachers, incorporating technologies to promote a more inclusive education that is aligned with local realities.

CASE STUDY: CONTINUING EDUCATION COURSE IN COMPUTING, TECHNOLOGIES, AND EDUCATIONAL ROBOTICS

The Continuing Education Course in Computing, Technologies, and Educational Robotics was created with the aim of training indigenous teachers in basic education at Federal Institute de Rondônia (Brasil, 2023a). This initiative promotes the integration of technological tools into the pedagogical practices of indigenous schools, strengthening traditional culture and digital accessibility (Mezzomo; Kawamoto; Wonsik, 2023; Brasil, 2023a).

The course aims to develop the digital competencies of teachers, enabling them to effectively use technological tools in their classes. The integration of artificial intelligence in image creation is one of the emerging technologies addressed (Escola Nacional de Administração Pública, 2024)

The appreciation of indigenous culture is a key pillar. Teachers are encouraged to incorporate traditional elements into their activities with the support of artificial intelligence, promoting cultural preservation and educational innovation (Fundação Nacional do Índio, 2024).

The course adopts an interactive approach, allowing teachers to immediately apply the concepts learned in their educational contexts. The methodology prioritizes cultural relevance and practice (Brasil, 2023a).

Participants come from diverse backgrounds, enriching discussions and the exchange of best practices. They have shown interest in exploring artificial intelligence in image creation (Fundação Instituto de Administração, 2021).

The target audience includes 150 indigenous teachers from villages, representing various ethnicities, and 100 teachers from urban schools and 50 from military schools (Brasil, 2023a).

INTEGRATION OF ARTIFICIAL INTELLIGENCE IN THE COURSE

The integration of Artificial Intelligence (AI) in the Continuing Education Course in Computing, Technologies, and Educational Robotics was a deliberate strategy to train indigenous teachers in image creation, with the aim of strengthening cultural appreciation and pedagogical innovation (Mezzomo; Kawamoto; Wonsik, 2023).

During the course, teachers participated in practical workshops, exploring generative AI platforms such as DALL-E, Midjourney, Leonardo, and Copilot. These tools enabled the creation of illustrations, infographics, and other visual resources aligned with their cultural visions and identities. This approach allowed teachers to develop a deep understanding of how to shape the outputs of AI tools according to their educational and cultural needs (Brasil, 2023a).

The integration of AI promoted a greater capacity for innovative visual representation of indigenous traditions and worldview. Additionally, teachers were encouraged to incorporate cultural elements into their creations, contributing to the preservation and promotion of indigenous cultures in the educational environment (Fundação Nacional do Índio, 2024; Brasil, 2023b).

METHODOLOGY

The methodology employed in the study, as observed in Mezzomo, Kawamoto and Wonsik (2023), investigated the application of Artificial Intelligence (AI) in image creation by indigenous teachers. This study was conducted in the context of a continuing education course in computing, technologies, and educational robotics for basic education (Brasil, 2023a), which is a materialization of the proposal of the Doctoral Project registered in the Postgraduate Programme in Sciences, Technologies, and Inclusion (PGCTIn) – Academic Doctorate. Approved by the ethics committee of the Federal Fluminense University (UFF), according to Opinion CAAE No. 66887723.0.0000.8160, the project reflected a continuous commitment to promoting inclusion and disseminating knowledge, specifically among indigenous educators in Basic Education (Brasil, 2023a). The study adopted a qualitative approach, including participant observations, image analysis, and data collection (Creswell, 2014; Braun; Clarke, 2006; Bowen, 2009).

During the course, teachers learned to use generative AI platforms such as DALL-E, Midjourney, Leonardo, and Copilot to create illustrations and infographics relevant to their pedagogical practices. The data collected were analyzed using content analysis, a qualitative analysis method that involves interpreting textual aspects of data to identify themes or patterns (Hsieh; Shannon, 2005; Patton, 2015).

DISCUSSION - RESULTS OBTAINED

Integration of AI and Ethnoinformatics: Fausto, Leta and Braz (2024b) research highlights an increase in the creative capacity and pedagogical engagement of indigenous teachers with the incorporation of Artificial Intelligence (AI) in image creation. Ethnoinformatics was essential, enabling the integration of (Fausto; Leta; Braz, 2024a). To enhance these results, it is recommended to encourage the incorporation of indigenous cultural elements in the images, promoting cultural identity. The richness of Amazonian socio-biodiversity should be explored through AI in creating images that reflect cultural and biological diversity in indigenous education (Vasconcelos and Freitas, 2012).

Digital Cultural Preservation: As reported by Fausto, Leta and Braz (2022), the innovative use of AI to digitize indigenous art has generated digital murals that preserve and revitalize traditional

myths and stories. This practice, supported by FIA (Fundação Instituto de Administração, 2021), illustrates the potential of AI in conserving indigenous cultural heritage. It is crucial to offer continuous training in AI technologies so that teachers can fully explore image creation tools.

Positive Educational Impact: FUNAI (Fundação Nacional do Índio, 2024) found that implementing AI in indigenous education increases students' interest in technology and reinforces cultural appreciation. The interactive and visual methodology enhanced the learning experience, fostering inclusive and technologically advanced education. To improve image analysis, it is advisable to establish a review and feedback system among teachers.

Engagement and Educational Material: The ability of teachers to create images with AI has transformed teaching practices, as reported by Indigenous Teacher B, resulting in greater student engagement and the incorporation of significant cultural elements in lessons. AI stands out as a valuable pedagogical tool. It is important to ensure that teachers have access to adequate technological resources to carry out these activities.

Evaluation of visual and Cultural Expression: The integration of artificial intelligence in indigenous education represents a significant advancement in how teachers can express and preserve the cultural richness of their communities. The images they create using AI tools are vivid reflections of a symbiosis between tradition and modernity, where ancestral symbols and contemporary visions merge into a new visual language. This evaluation seeks not only to appreciate the aesthetics and creativity of the works but also to understand how these visual representations can strengthen indigenous cultural identity and enrich the educational process.

Figure 1 presents a colorful illustration showing a group of indigenous people, including children and an adult wearing traditional attire, interacting with a robot. The robot stands on an open book displaying various symbols or icons. The setting appears to be a lush environment, possibly a forest, indicative of the indigenous community's habitat. Elements such as leaves and seeds scattered around the book suggest a connection between nature and technology.

Figure 1. Image Created by AI by Indigenous Teacher J.

Figure 1 is a powerful example of how technology, specifically Artificial Intelligence (AI), can be integrated into traditional indigenous life. The presence of the robot in the image suggests the possibility of using AI to assist in daily activities, while the inclusion of indigenous cultural elements indicates the importance of maintaining cultural identity even amidst the adoption of new technologies.

This also suggests that technology can be a tool for self-expression and creativity, as evidenced by the small robot on the tablet. This aligns with the view that digital inclusion is not just about access to technology, but also about the ability to use technology in meaningful and creative ways (Bonilla; Pretto, 2011).

It represents an optimistic and inclusive vision of the future, where technology and tradition coexist harmoniously. It serves as a visual reminder of the importance of digital inclusion in promoting equal opportunities and social inclusion (Amadeu; Silva; Manochio-Pina, 2022).

Figure 2 presents a fusion of traditional indigenous and futuristic elements. In the foreground, two hands hold a tablet displaying an image of a small robot dressed in indigenous attire and holding a similar tablet. The background shows an indigenous village with huts and individuals engaged in various activities, such as walking and flying kites. A large humanoid robot, mirroring the appearance of the small robot on the tablet, stands beside the village, extending its hand to a flying parrot. The setting sun creates a warm glow in the sky, casting long shadows on the ground.

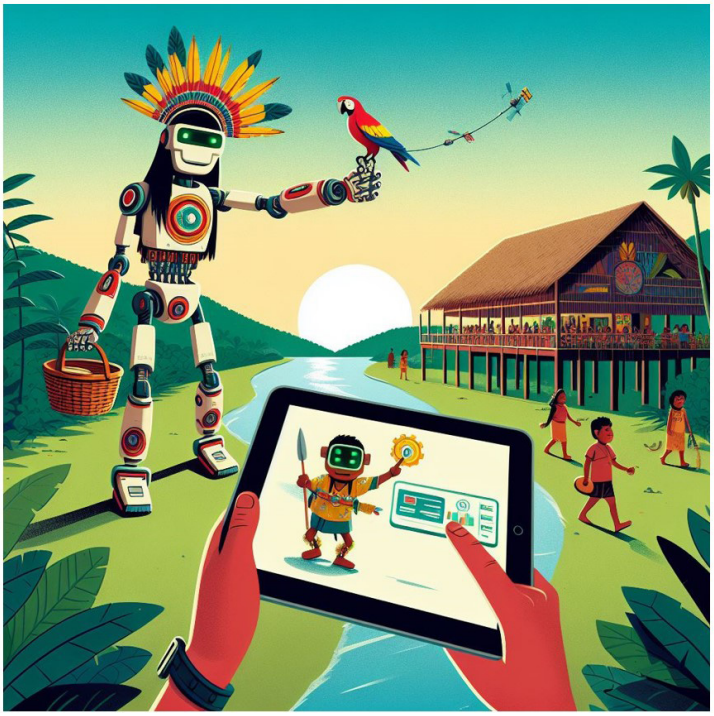

Figure 2. Image Created by AI by Indigenous Teacher D.

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Figure 3 is an interesting representation that combines traditional elements with modern technology, suggesting an integration of indigenous culture with contemporary technological advancements.

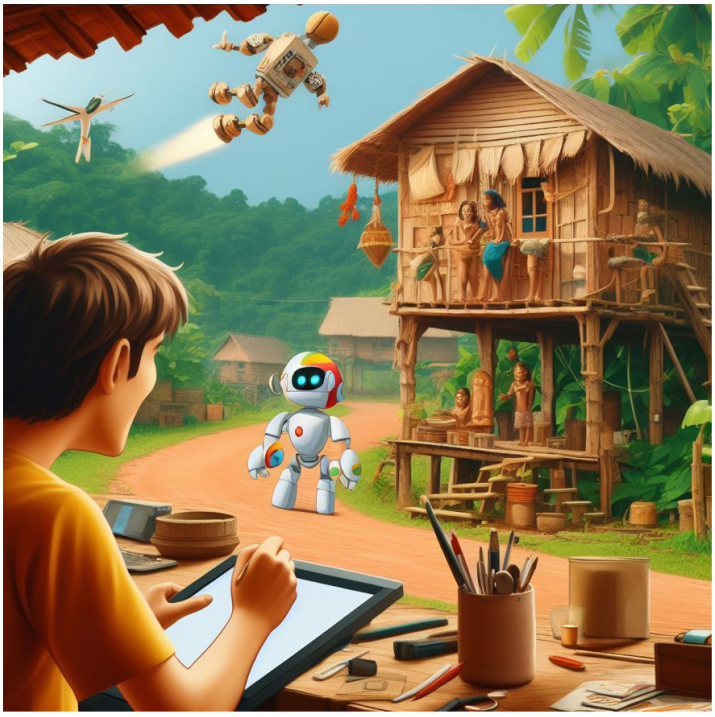

Figure 3. Image Created by AI by Indigenous Teacher A.

It shows a young person sitting outside a wooden stilt house, a representation of the beradeiros' dwellings, looking at a small robot standing on a table. The young person is holding what appears to be a stylus pen and interacting with a digital tablet displaying drawings. This can be interpreted as a representation of human-robot interaction in education, a topic of growing interest in educational technology research.

The tablet and the robot in the image can be seen as forms of assistive technology being used to facilitate the learning process. The presence of these devices suggests that technology is being integrated into indigenous education in innovative and culturally sensitive ways.

The wooden stilt house and the lush vegetation in the background are representative of the natural environment in which many indigenous communities live in the Amazon region. The inclusion of these elements in the image highlights the importance of culture and the environment in indigenous education.

Above the scene, there is a drone carrying objects and flying away from the house. This could symbolize the delivery of educational resources or other supplies to remote communities, a potential use of technology that is gaining interest in educational technology research.

This analysis is supported by authors such as Blikstein (2013), who discusses the importance of assistive technology in education, and Warschauer and Ames (2010), who explore the role of technology in promoting educational equity. Additionally, authors like *Cera Castillo et al.* (2015) discuss human-robot interaction in education, while Cavalcante, Mendonça and Brandalise (2019) explores the use of drones for delivering resources in remote areas.

In Figure 4, we observe that the community living on the riverbanks is known in the Amazon region as the "beradeira community." The *beradeira* communities are rich in popular

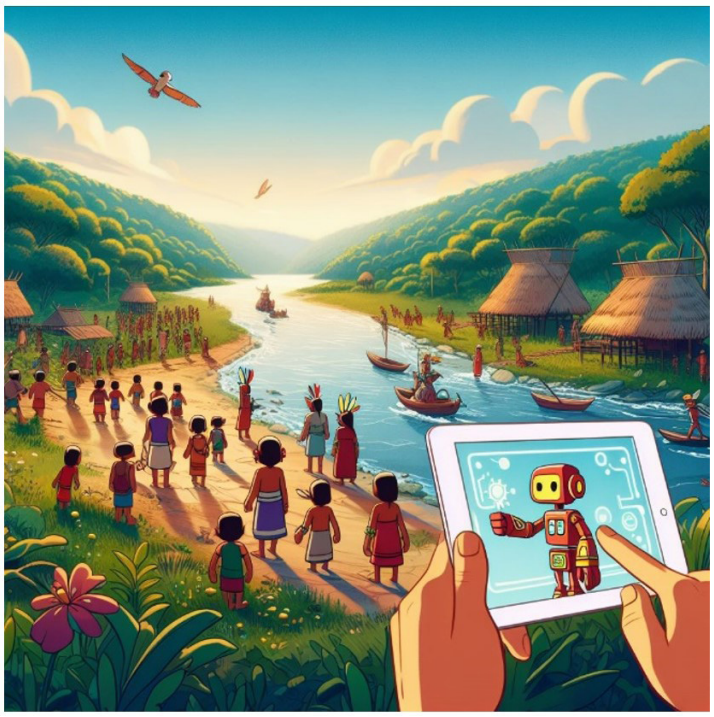

Figure 4. Image Created by AI by Indigenous Teacher J.

knowledge, traditions, and syncretism, and have a strong relationship with the rivers that run through their regions.

Figure 4 is a vibrant and colorful representation of a beradeira community by the river. Here is an enhanced technical and scientific analysis:

The community depicted in the image is a beradeira community, living on the riverbanks. The beradeira communities have a strong relationship with the river and depend on it for their subsistence.

In the foreground, there is an individual holding a tablet displaying an image of a robot with indigenous patterns. This symbolizes the integration of modern technology, in this case, Artificial Intelligence, into beradeira life.

In the background, community members are engaged in various activities, such as walking towards the river, boating, and interacting with each other. This represents the daily life in the beradeira community.

The stilt houses along the riverbank, the lush vegetation around the area, and the hills in the distance under a sky dotted with clouds depict the natural environment in which the beradeira community lives.

A small plane flying above symbolizes the presence and impact of the modern world on beradeira life, creating an interesting contrast between tradition and modernity.

This analysis is supported by authors such as Mateus Santos (2023), who discuss the importance of regional beradeira music as a powerful cultural expression rooted in the traditions and experiences of the riverbank communities. Additionally, Moura (2024) highlights the importance of community tourism for the development of Porto Velho, including the beradeira communities. Diniz and Diniz (2018) also discuss the importance of the knowledge and practices of *rezadeiras* and *benzedeiras* (prayer women and healers) in caring for health in the *beradeira* communities.

This image is a powerful example of how Artificial Intelligence can be integrated into image creation by indigenous communities, respecting and valuing their culture and way of life. It demonstrates that technology and tradition can coexist and enrich each other. The image created by the indigenous teacher is, therefore, not only a work of art but also an educational tool and a means of cultural expression.

FINAL CONSIDERATIONS

The project of integrating artificial intelligence (AI) in image creation by indigenous teachers, carried out in the continuing education course in computing, technologies, and educational robotics, demonstrated extremely positive results. The participating teachers explored the creative possibilities of AI, developing essential skills to apply them in their pedagogical practices.

Facing challenges such as the limited prior experience of some teachers with digital technologies and infrastructure limitations, the course was adapted to overcome these barriers, respecting and valuing the culture and traditional knowledge of indigenous peoples. The flexibility and adaptability of the course allowed indigenous teachers to learn new technologies and techniques quickly and efficiently, demonstrating their ability to reinvent and expand their skills.

The protagonism of indigenous teachers was valued, recognizing them as active agents in the process of integrating AI, which strengthened the sense of belonging and empowerment of the community. The use of AI inspired teachers to explore new forms of visual expression, combining indigenous cultural richness with technological possibilities.

With the promising results obtained, the pedagogical team plans to expand the project's reach, further integrating AI in image creation and exploring new tools and techniques that allow greater personalization and authorship by teachers. The creation of a collaborative network between universities, indigenous schools, and communities is envisioned to ensure the project's sustainability and the long-term appreciation of indigenous culture, making it a replicable model in other educational contexts.

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Editor: Prof. Dr. José Luís Bizelli

Executive Editor for Latin America: Prof. Dr. Vilmar Alves Pereira