

Generative Artificial Intelligence in Promoting Creative Thinking Skills in Deaf Students

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ABSTRACT

This article seeks to discuss the importance of using digital technologies (DT), especially Generative Artificial Intelligence (Generative AI) in the education of deaf students, in the relationship between image production and knowledge of the language - in this case of Portuguese as a second language (P2L). Visuality is fundamental in this process, given that Portuguese Sign Language (PSL) is a visual language and the acquisition of the Portuguese language by deaf students benefits from teaching based on images and visual resources through active learning methodologies that extrapolate exposure to the *imago* as a simple retinal experience. Despite recognizing the importance of visuality, theoretical references on this subject criticize the reductionist notion that deaf people learn only visually, questioning the assumption of an increased visuality in the deaf population as a decisive factor in cognitive processes and defending a broader approach, which consider multimodality in learning. Generative AI emerges as a promising tool to think about and develop individualized teaching strategies, create innovative visual resources and stimulate the creativity of deaf students.

Author Keywords

Generative Artificial Intelligence; Deafness; Creative Thinking; Language Learning

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous; See <http://acm.org/about/class/1998> for the full list of ACM classifiers. This section is required.

INTRODUCTION

Within the goals of the Portuguese Second Language for primary and secondary school student's official curriculum, mastery of the Portuguese language contributes to forming

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deaf individuals capable of thinking critically and creatively, making informed decisions, working as a team and respecting cultural diversity, preparing them for active participation in society [1].

According to the socio-anthropological model of deafness [2] for students to achieve the necessary skills so that they can express their ideas, defend their points of view, and build meaningful relationships with their peers, promoting their empowerment and social inclusion, the deaf student is ideally bilingual, progressively fluent between his mother tongue (PSL) and Portuguese (as a second language). The purposes of the P2L curriculum for primary and secondary school students, mastery of the Portuguese language contributes to forming individuals capable of thinking critically and creatively, making informed decisions, working as a team and respecting cultural diversity, preparing them for active participation in society [1]. It is advised, in all structuring documents of pedagogical *praxis* in Portuguese Deaf Education, that a visual approach to teaching be adopted, framed by a Deaf Pedagogy.

VISUALITY, IMAGE AND VISUAL COGNITION

In the document guiding teaching methodologies and learning objectives for P2L in primary and secondary education [1], the word "visual" appears twenty-eight times. The frequency of the word "image" is of fifty-three times, and this emphasis is given to the presence of the image and the so-called visual approaches in Deaf Education from Kindergarten to High School. It is reinforced that P2L should not be considered a foreign language but as a specific language for deaf students based on differentiated teaching from the perspective of progressive bilingualism process, given that Sign Language does not have a written register, but a combination of dimensions spatial-kinetic-visual on which its linguistic *corpus* is based. This step-by-step bilingualism is justified by the "PSL-image-P2L" interface, since the deaf person learns to read from what is perceived through vision, and the initiation into the Portuguese language is done in its written form, which is also visual.

The legislation regulating Inclusive Education in Portugal, set out in Decree-Law No. 54/2018 [3], also reviews the paradigm and operationalization of educational responses within the scope of bilingual education, highlighting the importance of visual support for deaf students (article 15.º).

According to this framework, reference public schools for bilingual education created within the scope of the previous Special Education legislation (Decree-Law no. 3/2008), must have specific equipment and materials capable of guaranteeing access to information and to the curriculum, notably equipment and materials to visually support learning. Still, despite the assumption of inclusive access to information and a curriculum based on visuality, the legislation leaves gaps about guidelines for the selection and use of visual equipment in the classroom context. The recurrent focus given to the assumption of the effectiveness of visually oriented learning, without the necessary support for the pedagogical-didactic and technological operationalization criteria in Deaf Education, has been defining the deaf as “visual learners” [4] conception that, substantiated by some persistent beliefs about learning styles, can hinder multimodal and multisensory approaches to curricula, which are more effective in the development of language and cognition of deaf students [5,6,7].

Understanding the conviction with which ideas about the deaf visual advantage are frequently conveyed in schools and strategies, teaching methodologies, and learning support methods based on images are defined (more or less tangible, analog or digital, with a greater or lesser degree of iconicity, static or moving), we also recognize the countless doubts among the teaching staff about the mechanisms necessary for the image to promote effective interface processes enhanced by visual cognition with a positive impact on learning.

Thus, research results that question a type of increased visuality in deaf individuals are here safeguarded, as well as questioning the effectiveness of the image in the teaching-learning process almost as an exclusively retinal experience and due to a compensatory neuroplasticity process in the face of sensory deprivation of hearing [8,9,10,11,12]. At this article there are aimed innovative possibilities to promote teaching and learning processes that are interdiscursive and multimodal through visually oriented creative strategies based on the use of digital technologies (DT), in particular Generative IA, in Deaf Education.

GENERATIVE ARTIFICIAL INTELIGENCE AND LANGUAGE LEARNING

Digital Technologies shape our daily lives, and the educational field is constantly transformed by the possibilities of their application, namely in language learning, particularly in the case of Non-Maternal Language (N-ML) where the offer of digital resources is vast [13]. As an example of the impact of DT on education, Generative IA has the potential to revolutionize Deaf Education, offering personalized and efficient tools to adapt curricula and create innovative resources and assessment instruments adjusted to different paces and learning profiles. Generative IA, especially tools that generate images from textual content, offers a new and promising path in the context of

P2L. Although the connection between Generative IA and N-ML learning has been studied, the intersection between Generative IA, deafness, P2L, and creative thinking is an emerging and promising field, with the potential to revolutionize the education and communication of deaf people. As verified, the research in the field of creativity in deaf individuals is scarce and focused mainly on the need to improve communicational aspects using virtual reality as an environment in which individuals with different levels of fluency in sign languages can relate through avatars, here particularly useful in the communication of deaf children of hearing parents [14]. There is, therefore, a recognized link between communication skills and critical and creative thinking, adding to this equation the increasing use of digital tools as facilitators of integral development.

LANGUAGE LEARNING AND GENERATIVE ARTIFICIAL INTELIGENCE: HOW WRITING EFFECTIVE PROMPTS CAN PROMOTE CREATIVE THINKING

In this text, it is assumed that the applications of Generative IA at the intersection of these areas (P2L, AI and creativity) can revolutionize the way students engage with written communication and reading processes and reinforce their knowledge of the Portuguese language, alongside levels of differentiating motivation given its visual ontology and deaf ethos.

The focus is given to the work of Gonçalo M. Tavares specifically on the award-winning work “O Senhor Valéry” [15] chapter named “Os Amigos” given its poetic and introspective prose, which presents an immense imagery potential, which manifests itself in different ways and contributes significantly to the construction of the image narrative and the reader's linguistic experience. It is considered that Gonçalo M. Tavares uses a language rich in figures of speech, creating vivid and evocative images that stimulate the imagination: the comparisons and metaphors, often unusual and original, invite the deaf reader to build their own visual representations of the settings and characters. Considering this literary work as a motto to explore the potential of effective prompt writing in Generative IA chatbots, we consider that creating effective prompts for AI applications is, in essence, a form of creativity engineering. By crafting and testing successive prompts, students provide instructions to an AI model to generate something new and original. This interaction between the deaf student (prompt creator) and the AI model can generate a synergy that boosts creativity in surprising ways. Also, in the case of “creative blocks”, effective prompting hypotheses provide new ideas, inspiration and creative fluency by making visible and more concrete, concepts that can be complex and abstract (such as the psychological traits of the protagonists or emotional manifestations that determine the written narrative. When working with the Generative IA model, it is possible to explore different approaches and find creative solutions to complex visual problems.

“O SENIOR VALÉRY”: AN EXAMPLE OF THE USE OF GAI AT THE INTERSECTION BETWEEN VERBAL NARRATIVE AND VISUAL NARRATIVE

A search was carried out for suggested programs to create images from text. From several alternatives (i.e., DALL-E, Midjourney, Stable Diffusion and others) two different free options of Image Generator were more explored. The writing of the indications at the Chatbot Apps from the original literary text were sufficiently complex to develop vocabulary, construction of sentences and semantic organization to formulate hypotheses that simultaneously articulate linguistic skills at the chosen teaching levels and at the same time create a credible relationship with the written narrative origin present in text, after its after its meticulous reading and interpretation (see Figure 1):



Figure 1. Image generated by text from "The Friends" using the prompt “A short old man in a hat and long beige coat passes a taller young man on the sidewalk and looks up at the top of his head”, using Open Art AI.

About this original story detail (see Figures 2 and 3): *“He then thought about freezing a jump. As if it were possible to suspend the force of gravity, just for an hour (he didn't ask for more), on his journeys through the city. And Mr. Valéry designed his dream, so common”* [15], the image was satisfactory after two attempts. The instructions were progressively more complete, direct and simple, with more effective prompts. The evolution in the writing of the message was linguistically significant in the illustration of a sequential mental image. However, the subjective processes present in the creation of the imagery linked to the story would always result in different prompts from student to student [16].



Figure 2. Image generated by text from "The Friends" using the prompt “Prompts: “an old man with a hat and a long beige coat is jumping” using Open Art AI.



Figure 3. Image generated by text from "The Friends" using the prompt “Prompts: “an old man with a hat and a long beige coat jumps with both feet together on the sidewalk when someone passes by”, using Open Art AI.

Following the Tavares story, prompts were tested to illustrate complex actions, moods and emotions of main character. It took several attempts, exploring different written semantic combinations and vocabulary fields combinations to arrive at images that satisfactorily illustrate the verbal content of the text (see Figures 4 and 5).



Figure 4. Image generated by text from "The Friends" using the final prompt "An old man wearing a hat and a long beige coat draws a pen drawing of a bench on a table at home".



Figure 5. Image generated by text from "The Friends" using the final prompt "a short old man with a hat and a long beige coat is sad and without friends", using Open Art AI.

CONCLUSION

Creativity provides a means to process and express emotions, which is crucial for mental health. For deaf individuals who may face isolation or frustration due to communication barriers, creative activities can be also therapeutic rather than just to pursue academic critical skills and problem-solving strategies. By combining human creativity with GIA's ability to generate images, from text and vice versa, it is possible to explore the semiotic multiplicity between different linguistic signs, privileging

their interrelations, in the association of meaning and signifier and in the construction of narratives. visual-verbal interdiscursive, with a view to greater academic achievement and academic progression. Furthermore, regarding inclusive aspects, motivation and perception of self-efficacy, engaging in creative pursuits can strengthen a deaf student's sense of identity, helping them to embrace their deafness as a unique aspect of who they are, rather than a limitation. It also empowers them by providing a voice in a world where they might otherwise feel unheard.

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