DEAFLYMPICS AND STEAM BETWEEN ALLIANCES AND INNOVATION

DEAFLYMPICS E STEAM TRA ALLEANZE E INNOVAZIONE

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ABSTRACT

The inclusion of deaf individuals in sports finds new opportunities in the Deaflympics, addressing communication and relational challenges. The STEAM approach offers innovative educational strategies to overcome such barriers, fostering empowerment, self-determination, and personal development. The integration of advanced technologies and inclusive methodologies enhances participation, promoting the overall well-being of deaf athletes.

L'inclusione delle persone sorde nello sport trova un'opportunità nelle Deaflympics, affrontando sfide comunicative e relazionali. L'approccio STEAM offre strategie didattiche innovative per modifcare tali barriere, promuovendo l'empowerment, l' autodeterminazione e lo sviluppo personale. L'integrazione di tecnologie avanzate e metodologie inclusive permette di migliorare la partecipazione, favorendo il benessere globale degli sportivi sordi.

KEYWORDS
Deaflympics; STEAM; deaf sportsmen; participatory re-generation; human formation.
Deaflympics; STEAM; sportivi sordi; ri-generazione partecipativa; formazione umana

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Introduction

The integration of scientific knowledge has undergone semantic shifts and changes in meaning that, over time, have led to ongoing technological developments.
The methodological reflections and innovative ideas that emerged after the Milan Congress (Gaspari, 2005; Ninassi, 2018) have increasingly affirmed the right of everyone to be themselves (Bouvet, 1986). This has enabled people with hearing impairments to develop the self-awareness that society is willing to accept and welcome them as they are (Pigliacampo, 1998).

‹‹Freedom, in fact, is the expression of an incessant problematization, of an exercise in which the individual experiences himself as a place of transformation, the subject of a becoming with history and in history, capable of re-discovering what it is possible to know, do and be›› (Gaspari, 2021, p. 160).

There are many difficulties in building relationships, as there are often missed opportunities for communication and connection—both between hearing and deaf people, and between deaf children and the Deaf community (Sacks, 1990). This means that deaf people often cannot ask questions that would help them understand themselves and their situation. Deafness can limit their opportunities and make it harder for them to redefine their life plans (Gaspari, 2021). These issues have been addressed in scientific and pedagogical literature and have also been represented in many films. Directors from different countries have used inclusive ‹‹language and gestures of care›› to highlight these challenges (Gaspari, 2021). Here emerge the different granularities of the plural criticalities. This is exemplified by the direction of Veronica Spedicati with the contribution of the Lazio Region and the Pio Istituto dei sordi (2025) in ‹‹Come Pesci nell'acqua›› (Daitona, 2024) available on RAIPLAY (2024). Through the voices of many participants, this film has highlighted the value of the Deaflympics (2024) and the difficulties that athletes encountered in Caxias Do Sul (Giffoni, 2024), during the games in Brazil 2024, and the difficulties they may encounter at the next Games in Tokyo (2025) and in future editions. There are, in fact, emotional, communication and relational barriers. The narrative film critically explores the experiences and perspectives of individuals engaging with the Deaf community, viewed through the framework of Special Pedagogy. The film also highlights the challenges faced by instructors, who often experience discomfort as they attempt to communicate and adapt advanced strategies to athletes. This difficulty in conveying higher-level connections and

tactical concepts can impede athletes' performance during competitions, as well as affect their aspirations, self-perceptions and re-presentations (Gaspari, 2021).

1. A possible alliance: STEAM strategies and the Deaf World

Reflecting on these considerations, it becomes clear that the STEAM approach addresses many critical aspects of inclusion. Therefore, Science, Technology, Engineering, Arts, and Mathematics-STEAM (Perignat & Katz-Buonincontro, 2019) emerges as a promising framework for strengthening the connections between digital environments and inclusive teaching strategies (Conte & Minerva, 2023), especially for athletes with hearing disabilities. It could represent a pivotal change toward a functional framework that prioritizes communication and the refinement of tactics. It has the aim of fostering enhanced relational connections among deaf athletes. This aspect is particularly significant for the deaf community. It presents both a challenge and an opportunity to make education more people-centered and innovative (Khine & Areepattamannil, 2019). This approach, which has been described since the last century (Dickinson, 2022), seeks to integrate the separate disciplines into a cohesive educational model. It is recognized as an effective strategy for developing transferable skills, fostering creativity, and promoting social inclusion (Bertrand & Namukasa, 2020). Adapting STEAM teaching methods for students with hearing disabilities is considered an innovative approach (Henriksen, 2019). This adaptation helps ensure guided and focused access to learning opportunities, which is especially important for supporting the potential of every student (Mejias et al., 2021). Providing a dedicated learning environment (Herro et al., 2019) can further enhance these benefits. This type of teaching also supports the creation of new and more inclusive educational opportunities (Baratè et al., 2019). Current literature shows that STEAM encourages students to solve complex problems by thinking critically and creatively, and helps them communicate their ideas clearly (Abbassi, 2017; 2020; Braun et al., 2017). Liao (2016) highlights that STEAM education constitutes a unique opportunity to promote a transdisciplinary approach, thus improving students' experiential learning.

The STEAM educational approach, as a conjunction of special pedagogy, special didactics (Herro et al., 2018) and STEAM Didactics (Rivoltella and Panciroli, 2025) may offer significant benefits for deaf students, affording them tools and methodologies. All that can be adapted to meet their specific needs. For example,

the use of virtual reality (Canfarotta & Pipitone, 2024) and immersive technologies (De Angelis, 2022) that allows students with hearing disabilities to actively participate in interactive learning environments, transforming communication barriers and improving engagement (Mystakidis et al., 2023). An exemplary case is represented by the project developed at the University of Patras, which involved deaf students in the creation of virtual exhibitions, allowing them to express themselves through digital and analog artifacts, with positive effects on their social and digital skills.

From an educational perspective, adopting an inclusive STEAM approach requires careful lesson planning that considers the various learning needs of deaf students. The use of teaching methodologies based on "learning by doing " (Buccini, 2024) and peer collaboration has proven to be particularly effective, allowing students to develop practical and communication skills through concrete experiences. Above all, using coding and educational robotics tools within STEAM activities (Baroni et al., 2023) gives students the chance to improve their problem-solving and executive skills. These tools help students work independently and think creatively. They also support the development of tactical, reflective, and strategic skills, which teachers need to organize in ways that are clear and meaningful for everyone (Panciroli & Rivoltella, 2023). A further element of relevance is represented by the role of teachers and instructors, who need specific skills to effectively implement STEAM strategies. Continuous training and the adoption of co-design models (Bertoncello et al., 2024) among teachers, instructors and STEAM experts are crucial for the creation of accessible and stimulating learning environments (Perignat & Katz-Buonincontro, 2019). So the didactic construction of STEAM for deaf students represents a promising path for the promotion of innovative teaching (Shatunova et al. 2019) for the deaf learner (Maragna et al., 2013), offering a participation in the knowledge society and in life with fullness and satisfaction.

2. The importance of STEAM Education for Deaf People

STEAM tactical and strategic pathways represent a pulsating educational aspect of key 21st century skills (Costantino, 2018). When applied to the context of the inclusion of deaf people, this approach becomes a powerful tool to address communication barriers and promote extraordinary learning opportunities. It is at enabling what has been described as ‹‹authentic participatory re-generation, […] as

a privileged place where one can recompose one's life and redesign new spaces and times of human existence›› (Gaspari, 2021, p. 190).

Deaf people encounter many challenges in educational and social contexts. These difficulties are often exacerbated by the absence of coherent and inclusive tools and teaching methods. As a result, deaf individuals may struggle to participate fully and access learning opportunities. For example, the use of intuitive visual interfaces and immersive learning environments can improve the conceptual understanding of deaf students, providing them with an autonomous and interactive learning experience (Khine & Areepattamannil, 2019). One of the unavoidable aspects of inclusion is the creation of educational environments that reflect the specific needs of deaf students in the manner of Pendolo and Provolo (Crispiani, 2016). They argue that a truly inclusive education is possible only through flexible and integrated teaching approaches. These approaches should help every student reach their full potential and encourage them to take an active part in science and technology. Experiences like the Deaflympics show that sport can represent a context for personal growth and recognition. At the same time, STEAM activities offer opportunities for reflective learning. Coding projects, scientific experiments and the use of technology for visual communication and mainly for the integration that can allow them to explore new possibilities of expression and different participation.

Deaf people often develop advanced visuo-spatial skills compared to the general population. These abilities can be a valuable resource in STEAM education. The STEAM approach can use visuo-spatial skills to support and mediate learning for deaf students. Reflective activities, like creating digital projects or programming robots, help students use their skills fully and make it easier for them to take part in learning. Using teaching methods based on learning by doing, together with collaboration, creates meaningful and motivating learning experiences for deaf students. These students especially benefit from activities that help them reflect and process what they learn. Although this requires the presence of teachers continuously trained in the use of assistive technologies and inclusive methodologies. Otherwise there is the risk that deaf students remain excluded from the educational opportunities offered by STEAM (Spada et al., 2024).

3. Tradition and innovation: from Provolo to STEM for the Deaflympics

Deaf education has changed greatly over time. There have been important advances, but many challenges remain. Issues of inclusion and equal access to educational opportunities are still present. Historically, the approach to deaf education has evolved through different methodologies, with pioneering attempts such as those implemented by Antonio Provolo in the 19th century. Provolo understood the importance of targeted and structured instruction, adopting strategies that would allow students to help favor their social and work integration. He introduced a method that combined articulation, lip reading, and the use of singing as tools to develop the linguistic skills of deaf students. This vision, although innovative for the time, reflected the need to adapt teaching to the peculiarities of each student, a principle still valid today in the context of STEM.

In the era of awareness of the Special Educational Needs of deaf students, the systematic use of assistive technologies and pedagogical and didactic methods dedicated to autobiographical inclusion, or for the self, is consolidated.

Innovations in the field of artificial intelligence, augmented reality and tactile interfaces have the potential to break down communication barriers and improve the accessibility of educational content, but all ethical and relational implications must be taken into due consideration. Tools such as automatic subtitling, real-time translators for sign language and interactive software are transforming the way in which deaf students can interact with scientific subjects. However, the implementation of such tools requires a structural commitment that involves the global context. Inclusive action (Aiello & Giaconi, 2024) involves a change in cultural perspective (Bocci, 2021): deaf education should not be seen as an attempt to fill a gap, but as an opportunity to enhance different ways of learning and expression. The concept of deaf pedagogy emphasizes the importance of an approach based on the valorization of sign language and deaf culture, recognizing that visual and gestural communication represents a fundamental resource in the educational path. Mentoring experiences, specific tutoring programs and inclusive learning environments can help reduce the sense of isolation often felt by deaf students, favoring their active participation and the achievement of significant academic goals (Giaconi, 2024). Educational institutions must therefore adopt a proactive approach, actively involving the deaf community in the design of educational paths and in the implementation of inclusive policies.

3.1 New Frontiers in STEAM for the Deaf

A key factor that can help deaf students succeed in STEM is having positive role models to look up to. The visibility of successful deaf scientists, engineers and professionals can inspire the new generations and demonstrate that barriers can be overcome with the right support. Promoting events, seminars and awareness programs that involve key figures of the deaf community is essential to create a culture of inclusion and stimulate interest in scientific disciplines, underpinned by the adoption of the ‹‹phases of professional pedagogical action›› (Crispiani, 2022, p. 12). This approach can be organized into steps: prevention, assessment, planning, and monitoring. These steps help connect everyone involved and guide deaf students along their STEAM education pathway. It is requiring a deep and collective commitment from institutions, teachers, students and families. It is essential to promote educational policies that recognize the specific needs of deaf students and that guarantee them equal access to learning opportunities. Only through an integrated and collaborative approach will it be possible to build an educational system capable of valorizing everyone, regardless of their hearing ability, and encouraging active and conscious participation in STEAM disciplines.

The integration of deaf students in STEAM subjects represents a crucial challenge in the current educational context. The peculiarities related to deafness require an in-depth reflection on the barriers that can interfere with the academic and professional path of these students, as well as on the strategies to be adopted to promote a more equitable and accessible education. The experience of those who have undertaken studies in these fields demonstrates that deafness does not represent an insurmountable obstacle to academic and professional achievement, but rather an opportunity to rethink teaching practices in an inclusive perspective (Braun et al., 2018). However, critical issues remain related to the poor preparation of teaching staff, the lack of adequate resources and insufficient awareness of the specific communication needs of deaf students (Abbasi et al., 2020).

An interesting key element in the inclusion of students with hearing disabilities is the availability of accessible educational resources, both in terms of technological support and the adaptation of study materials. Tools, such as, automatic subtitles, sign language interpreters and interactive digital platforms can significantly contribute to bridging the communication gap and ensuring equal access to information (Rodrigues et al., 2021). The personalization of educational paths, adapted to the different learning modalities of deaf students, represents a further

step forward in promoting an inclusive learning environment (Cannon & Luckner, 2018). Evidence from several studies suggests that, to achieve a tangible improvement in the school integration of deaf students. This implies not only the adoption of differentiated teaching strategies, but mainly the creation of contexts that favor the full participation of students in educational activities (Prinzi, 2019), considering that inclusion passes through that civic commitment that aims to build a community welfare that enhances diversity. In an educational context like STEAM, in which conceptual understanding and interaction with laboratory and practical environments are central, it is necessary to develop teaching models that favor interaction between peers and access to experiential learning experiences (Qiao et al., 2022). Inclusive practices, such as mentoring by deaf professionals or experts in inclusive education, have proven to be fundamental in improving students' sense of belonging and motivation (Braun et al., 2017).

The systematic mix of educational digital applications and applications is one of the possible alternatives for the generation of effective strategies to bridge the gap between the needs of deaf students and traditional teaching methodologies (Holmer et al., 2020). Recent studies have highlighted how digital platforms adapted to the needs of deaf students can significantly improve their academic performance, increasing autonomy in learning and reducing the sense of isolation. However, it is important to regularly check whether these tools are truly effective. It is also necessary to ensure that they are easy to use and meet the needs of all students.

Another critical aspect concerns access to higher education. Deaf students pursuing STEAM studies often encounter difficulties in career guidance and in choosing careers that match their skills (Epstein et al., 2021). In these cases, the sporting context, such as the Deaflympics, can also become a natural career path for deaf students. For example, participation in the Deaflympics may lead to further progression, such as moving from the Deaflympics to the Paralympics.Therefore, the creation of support networks and specific guidance programmes for deaf students could facilitate the transition from the academic to the workplace, helping to reduce dropout rates and incentivise active participation in highly specialised sectors. Despite the progress made, continued commitment from educational institutions is needed to promote equitable and inclusive access to STEAM disciplines. Collaboration between universities, deaf associations and industries can help develop new educational and technological solutions capable of responding to

the needs of an increasingly heterogeneous student population (Lillo-Martin et al., 2019).

The inclusion of deaf students in STEAM should be regarded not only as an ethical and legal imperative, but above all as an opportunity to enrich society as a whole. Future perspectives focus on the adoption of accessible digital tools, the personalization of educational paths and the integration of maker culture (Moreira et al., 2023) as a key element for the development of practical and cognitive skills. According to Moreira et al., (2023), maker culture, characterized by a practical and collaborative approach, offers enormous potential for the enhancement of STEAM skills, especially among students with special educational needs, such as deaf people. The adoption of maker laboratories and the use of technological tools, such as robotics and 3D printing, allow students to learn experientially, strengthening their visuo-spatial skills and promoting greater autonomy in learning. This approach is particularly effective for deaf students, who benefit from a visual and interactive learning environment that overcomes traditional communication barriers. STEAM education can also be used as a tool to raise student awareness of issues of public interest related to sport. Dias et al., (2024) highlighted how educational activities based on the STEAM model are effective in addressing complex issues, such as the prevention of vector-borne diseases, through methodologies that connect scientific research to educational practice. The integration of these approaches in the context of deaf education can foster not only the acquisition of scientific knowledge, but also the development of greater social and environmental awareness.

Another key aspect for future prospects it is the personalization of STEAM learning experiences, adapting methodologies to the specific needs of deaf students. Using immersive technologies, such as augmented and virtual reality, it is possible to offer inclusive educational paths that facilitate the understanding of scientific concepts in a visual and intuitive way. Moreira et al. (2023) underline the importance of integrating problem-based learning and project-based learning methodologies, which allow students to develop problem-solving skills and work in collaborative and interdisciplinary contexts. STEAM education can help create that self-supporting bridge between the world of school, university and society, offering opportunities for personal and professional growth for deaf students and the articulation of collaborative and reflective activities, involving educational institutions, families, companies and stakeholders can foster inclusion in the world of work and promote a culture of equity and active participation. Future prospects

therefore suggest an increasingly personalized, accessible and inclusive STEAM education, capable of enhancing the skills of all students, regardless of their hearing ability.

4. Inclusive STEAM Education for Deaflympic

The innovative directions of sense of care offer opportunities for re-thinking and existential re -generation. Therefore, it is essential to make available devices, such as STEAM, aimed at the emancipation of people so that they can excel in their personal history, in the Deaflympics or Paralympics and more.

Many opportunities, which go beyond simple normalization, help people with Special Educational Needs improve their inclusion through STEAM disciplines. Innovative strategies and proactive approaches address multiple aspects of learning, creating complex but supportive environments. These environments encourage the use of digital tools, such as personalized learning applications and automatic captioning systems. These tools can significantly improve access to STEAM content for deaf students (Holmer et al., 2020), although challenges remain when it comes to interpreting content that is only partially contextualized or metaphorical. Mentoring and role models also play a key role for deaf individuals. Targeted mentoring programs have been shown to foster a sense of belonging and reduce dropout rates by creating supportive environments based on direct experience (Braun et al., 2017). Moreover, promising collaborations between institutions and the deaf community can lead to effective partnerships among universities, research centers, and associations of deaf people. These partnerships can support the development of inclusive teaching materials and personalized learning environments (Lillo-Martin et al., 2019). It is also important to consider the knowledge, perception and participation of deaf individuals in dedicated and multi-profile events. For this reason, it is necessary to promote both the Deaflympics and other sporting events. Developing STEAM skills can support training and the customization of sports devices and equipment for deaf participants. Events such as the Deaflympics represent a precious opportunity to raise public awareness on the importance of inclusion, personal affirmation and the career of the person, creating a bridge between sport and scientific and technological disciplines. Although there have been many advances in the field of inclusion, there are still few inclusive and cross-disciplinary STEAM projects. This leads to unequal access to

educational opportunities. Sometimes, this is due to limited funding for research and for the use of inclusive teaching methods in STEAM subjects. As a result, it is difficult to implement these approaches widely. (Epstein et al., 2021). There are also difficulties in adapting teaching materials, since most educational content is not designed considering the specific needs of deaf students, making it necessary to adapt it, which requires significant time and resources.

To promote the spread of innovative, effective, and inclusive practices, it is essential to adopt targeted strategies. These strategies should involve both teachers and coaches, and focus on improving the learning environment. Enhancing expertise and encouraging the use of inclusive digital tools—such as interactive platforms that support sign language—are key steps. These actions help create contextualized and situated learning experiences. The result is not only equal access to educational resources but also an expansion of learning opportunities for all students.Transdisciplinary collaborations are desirable to promote synergies between universities, technology industries and institutions and associations of deaf people to develop innovative and sustainable educational solutions to activate awareness campaigns to promote an inclusive culture. It is very important to prepare students to know the Deaflympics to invest everyone within educational institutions, also towards the competitive and professional context of STEAM disciplines. This is one way to favor the experiences of the body and movement, simultaneously starting pilot projects to evaluate the effectiveness of the synergies of the strategies and then start small-scale experiments to explore new educational approaches before their large-scale implementation.

The inclusion of deaf students in STEAM disciplines represents an important objective for the construction of an educational system that helps them to know that through training they can change their lives. Institutions, professionals and events such as the Deaflympics constitute those complex scenarios that can be thought of as those privileged time of existential transformation and an acological places. Here, the language of inclusive practices and gestures of care, addressed by people with Special Educational Needs to themselves and others—can spread as both an evolutionary act and a gift from the community of care, where the re-compositional whole ‹‹fully assumes the relationship with the future›› (Mancini, 2009, p.27).

Conclusions

Inclusive education in STEAM disciplines for the Deaflympics represents a multidimensional challenge. This requires an integrated and care-based approach, whose success depends on the ability to metamorphose the barriers of proximity and community, adopting teaching strategies centered on the person and their life. A human-centric approach is thus fundamental to building educational paths that meet the specific needs of each individual, supporting their well-being and full potential.

The transformation of didactic approaches for deaf students in STEAM subjects must be viewed as an investment in long-term educational outcomes, not as a one-time intervention. This means fostering enduring relationships within educational contexts that promote a sense of belonging, collaboration, and empowerment among deaf students.

Therefore, it is essential to provide teachers with specific and scientific training, as well as ongoing support. Educators need multidisciplinary skills to address the needs of deaf students from a relational perspective. Teaching staff should develop a deep understanding of assistive technologies and inclusive pedagogical methods. It is also important that they build cultural awareness, recognizing and valuing the unique perspectives that the deaf community brings to the hearing world. Continuous training, combined with an institutional support network, can help create a community of educators capable of responding effectively to the challenges posed by deafness and promoting inclusive values. Here we now turn our gaze towards STEAM, which in this case embraces the sports processing in question and which can also find further implementation in Situated Learning Episodes (EAS) (Rivoltella & Panciroli, 2025). It is therefore essential that future research in the field of inclusive education and STEM for deaf people focuses on new teaching methodologies and the analysis of students' learning experiences, to develop increasingly effective and sustainable educational practices. It is necessary to embrace an inclusive vision that will allow us to build a future in which all students, regardless of their hearing ability, can access quality education and contribute significantly to the knowledge society.

Finally, the Deaflympics, which since 1924 have offered deaf students the opportunity to apply their knowledge in real, highly motivating and fulfilling contexts. The meeting of sport, education and science represents a unique opportunity to develop transversal skills, such as teamwork, leadership and creative

problem solving, helping to strengthen everyone's self-esteem and sense of belonging.

The future of the development of deaf children lies in the relational capacity to communicate disability, advanced technologies, learning environments to generate stable frequencies and inclusive atmospheres in a robust network of belonging (Gaspari, 2024), since by generating an approach of care and attention to the specificities of each one it will be possible to create opportunities for personal and professional growth for all. A joint and sustainable commitment will be essential to ensure that no one is left behind and that all deaf students can fully develop their potential.

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