

Extending education and outreach in optics with the visually and hearing impaired

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Abstract

We present the beginning of an ambitious project to extend initiatives of education and research in optics and photonics for population with disabilities. Specifically, we describe an activity organized by different student chapters in countries of Latin America geared towards the discussion and development of materials to teach optics and astronomy with and to the visually and hearing impaired. The particular event has been completed twice, once remote, in 2020, and another hybrid in 2022, with the in-person section hosted in Bogota, Colombia with remote participants from several countries. The event aims to develop educational materials, create a space for synergy interactions between different populations, and facilitate the expansion to different languages and regions in the Americas, particularly to reach under-served and remote communities. Different spaces are proposed and quantitative outcomes are provided.

1. INTRODUCTION

Since the late 1990s, there has been a critical emphasis on the ideas of diversity, equity, and inclusion (DEI), with increasing recognition of their significance and importance in society. Diversity is a reflection of the qualities and characteristics that make individuals unique, including factors such as gender identity, ethnicity, race, disability, sexual orientation, national origin, tribe, caste, socioeconomic status, and thinking styles.

Equity is another essential component of DEI, aiming to ensure that all individuals have equal opportunities and access to resources. This means promoting fair treatment for everyone, regardless of their background or identity. By prioritizing equity in scientific practices and policies, we can promote a more just and inclusive scientific community. Lastly, inclusion refers to the actions and behaviors that make everyone feel welcome and valued in science. This can involve actively seeking out and encouraging diverse perspectives, promoting collaboration, and fostering a culture of belonging. By embracing inclusion, we can create a more welcoming and supportive environment for everyone, which is crucial for promoting diversity and equity in science.

There is a growing understanding that diversity advocacy, and equal opportunity are essential for strong teams. However, there are pronounced disparities that restrict many people's access to basic opportunities at the institutional, individual, and systemic levels. To close the gap, it's necessary to construct environments based on respect and dignity, with a wide range of equity-promoting initiatives that involve the most marginalized.

The term "people with disabilities" refers to individuals who have physical or mental conditions that limit their participation in activities and interactions with the outside world. Visual, hearing, motor, and cognitive impairments are among the most common types of disabilities. However, it's important to recognize that people with disabilities form a diverse group with a wide range of needs. For instance, people with the same type of disability may be affected differently, and some disabilities may not be readily apparent. This highlights the need to adopt inclusive practices that cater to the unique needs of each individual with a disability.

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The phrase "Nothing about us, without us" has been a powerful rallying cry within disability groups for many years. It emphasizes the need for political action and the development of solid partnerships with communities of persons with disabilities [1]. Creating a culture of access with and for people with diverse-abilities/disabilities is crucial for building inclusive and innovative work settings. However, achieving this requires changes in fields such as public health, education, and civil rights.

An inclusive, equitable, and diverse society requires providing accessible and quality education that fosters learning opportunities, particularly for individuals with disabilities. Education is the fourth UN Sustainable Development Goal for 2030 [2], highlighting the critical role it plays in creating a more just and compassionate society. It's essential to recognize that education is a fundamental human right and that everyone, including individuals with disabilities, deserves access to quality education. By prioritizing inclusive and equitable education, we can create a society that values diversity and promotes equal opportunities for all.

Creating a diverse academic environment that is inclusive of individuals with disabilities requires restructuring current ideas and developing creative activities and access opportunities that cater to everyone's needs without limitations. Achieving this goal is not an easy task and cannot be accomplished in a short period of time. It requires a fundamental shift in the way we approach teaching and learning. However, the good news is that research is increasingly shedding light on the issues and biases faced by underrepresented individuals, including those with disabilities in STEM fields (science, technology, engineering and mathematics). This growing awareness is an essential step towards promoting equity in these fields. Nonetheless, it's important to recognize that most STEM diversification initiatives have yet to address the specific challenges faced by individuals with disabilities. Therefore, it's crucial to continue advocating for disability inclusion and promoting access to education and careers in STEM for people with disabilities.

2. MOTIVATION

Under the global context described previously, this work is focused in Latin America in general and in Colombia in particular. Colombia's minorities (and minoritized), including those with disabilities, indigenous peoples, Afro-descendant communities, people displaced by conflict and violence, and rural residents, face significant social and economic inequality. This issue is one of the country's most pressing problems.

According to the National Disability Survey (END) conducted in 2018 by Colombia's National Administrative Department of Statistics (DANE), 9.8% of the nation's population has some form of physical, intellectual, sensory, or mental disability. Of these, 2.7% have visual impairment and 2.6% have hearing impairment [3].

Over the past 25 years, there has been significant progress in protecting the civil rights of people with disabilities. This progress has been made possible through the implementation of public policies and the support of international organizations that seek to promote the formulation and recognition of their fundamental rights. These efforts have provided resources and actions that allow people with disabilities to enjoy a better quality of life in a context of social, economic, and political inclusion [4].

The population with impairments now faces significant barriers to accessing the educational system. 0.32% of pupils in Colombia have disabilities, and the majority of them are centered in early-childhood grades [5]. The lack of availability, accessibility, acceptance, and flexibility of education creates a serious condition of exclusion for students with disabilities in Colombia. Unfortunately, data on this issue are limited [6], but what is available paints a troubling picture.

It is clear that many students with disabilities in Colombia are not receiving the support and accommodations they need to fully participate in the educational system. This situation results in a significant gap in educational opportunities and outcomes between students with disabilities and their non-disabled peers.

To address this issue, it is essential to prioritize the development and implementation of policies that promote inclusivity and accessibility in education. This may involve providing specialized training for teachers and administrators, investing in assistive technologies and resources, and working with families and communities to promote acceptance and understanding of disability. By taking these steps, Colombia can begin to build a more equitable and inclusive education system that meets the needs of all its students.

Within the educational policies that promote the rights and freedoms of the population with disabilities, there are currently in force the Law 115 of February 8, 1994, which is the general education law, Decree 2082 of 1996, which regulates educational attention for people with limitations, abilities, or exceptional talents, Resolution 2565 of October 24, 2003, which establishes the parameters for the provision of educational services to the population with special educational needs, Law 1346 of July 31, 2009, which approves the United Nations Convention on the Rights of Persons with Disabilities, and Statutory Law 1618 of 2013, which establishes provisions to guarantee the full exercise of the rights of people with disabilities [7]. Moreover, there are pedagogical guidelines in place to support educational opportunities for students with disabilities. Despite this, there are still uncertainties surrounding these guidelines, and some regulations are not being fully implemented. Some educational institutions may decline to provide these services due to inadequate infrastructure, insufficiently trained teaching staff, or a lack of resources [8].

The Ministry of National Education has included accessibility for individuals with disabilities as a point in the National Development Plan. This plan emphasizes the importance of securing their rights as a cornerstone of human dignity and aims to create favorable conditions that promote well-being [9]. Additionally, a new inclusive education policy framework is being developed to support government organizations like the National Institute for the Blind INCI (Spanish acronyms) and the National Institute for the Deaf INSOR (Spanish acronyms) by ensuring that education is of high quality, accessible, and relevant. In this regard, a number of groups in Colombia are developing ways to close accessibility gaps in education for the people with disabilities. The Bogotá Planetarium, which established spaces like "Inclusion Week," a space where activities are carried out to reflect on diversity and inclusion in astronomy, is one of the most notorious regional events. The Medellín Philharmonic Orchestra's "I am a musician" program, which aims to promote musical involvement among children and young people with disabilities while also protecting their right to culture, is very significant. Finally, the Transversal Academic Project for the Training of Teachers for Populations with Special Educational Needs of the District University FJC (NEEIS) has launched a program to prepare teachers with an integral training embracing diversity.

The GOMa student chapter of the Francisco José de Caldas District University and the CIOR chapter of the Technological University of Pereira, as agents of change in Colombia and motivated to contribute towards closing the gaps generated by exclusion, have undertaken the challenge to discuss the question of "How to teach science, particularly optics, to a person with a disability?" with the aim of promoting active participation and ownership of scientific culture in this population. With this in mind, the National Meeting on Science Education for Inclusion - ENECI, is created as a space for dialogue, designed to share experiences, projects, and reflections around the issues faced by people with disabilities.

3. THE ROLE OF STUDENT CHAPTERS

Student chapters in optics and photonics are vital for creating a bridge between academic programs and the community, especially when it comes to outreach activities. These chapters organize events that bring together experts in the field with students and the public, providing a platform for sharing knowledge and discussing new ideas. They also serve as a hub for organizing outreach activities that promote science education, reaching out to students from kindergarten up to graduate school levels, and even on the streets. Additionally, student chapters can create and propagate spaces to teach and learn from the hearing and visually impaired, providing inclusive opportunities for all students to learn about optics and photonics. Overall, student chapters in optics and photonics play a crucial role in creating a robust and inclusive community around the study of light and its applications.

Latin America has a thriving student community that is eager to create programs focused on outreach and community engagement, particularly in underserved areas. Colombian student chapters from the OPTICA society and the International Society for Optics and Photonics (SPIE) are prime examples of this trend. The OPTICA Student Chapter GOMa has been actively involved in organizing events and activities focused on promoting science education and outreach in different areas of the city of Bogotá. They have collaborated with local NGOs to bring science education to underserved communities, organized workshops on optics and photonics, and developed outreach programs that provide hands-on experiences with scientific equipment.

Similarly, the SPIE Student Chapter at the Technological University of Pereira, CIOR, has been actively engaged in outreach activities to promote science education in the community. They have developed a program that provides science education to elementary school students and have organized workshops on optics and photonics for high school students.

The student chapters in optics and photonics in Colombia are part of a larger movement in Latin America that aims to engage with different communities and promote science education in places where other institutions do not arrive. These chapters are providing a platform for students to collaborate and share knowledge, organize events and activities, and make a positive impact on society. Through their efforts, they are not only promoting science education but also inspiring a new generation of scientists and engineers who are committed to making a difference in their communities.

4. STRATEGIES

In 2019, the CIOR and GOMa chapters joined forces to create strategies for promoting scientific knowledge convergence for researchers, educators, and students interested in reducing inequalities. The main strategy was to organize the ENECI event, which took place in 2020 and 2022, focusing on people with diverse abilities, primarily those with hearing and visual impairments. The event attracted 23 national and international speakers who had worked on inclusion projects, addressing educational problems from four different areas: optics, astronomy, teaching/pedagogy, and natural sciences.

The chapters collaborated with people with disabilities and entities working with this population in the country and Latin America to develop activities such as roundtables, workshops, and conferences led by guests with diverse trajectories in teaching and science. Sign language interpretation was provided in several conferences and workshops, enabling individuals with hearing disabilities to participate and engage with the content.

The activities included the creation of pedagogical proposals, call-for-papers sessions, and poster sessions. Two such sessions were titled "Recognition of Inclusive Pedagogical Interventions in Natural Sciences" and "Diversity and Inclusion in Science." These sessions were intended for teachers and students of pedagogy, science, and engineering who work with people with disabilities. The aim was to raise awareness of the unique and individual educational needs of students with disabilities, which can either enable or prevent their access to the learning experiences established in the school curriculum. The poster sessions gathered initiatives from different cities and from professionals in different fields like astronomy, optics, engineering, chemistry and pedagogy. Some of the ideas were related to products and transfer of knowledge.

To address some of the pedagogical context's needs, the First Basic Braille Workshop called "It's time to learn to be inclusive" was created in 2022. The workshop lasted for one month and received a great response from students, teachers, and people with disabilities, leading to the later creation of a call for a children's story contest in Braille. Additionally, short workshops on basic optics teaching were held for teachers and people with visual disabilities, particularly children and adolescents, to promote access to new tools for inclusive education in this area.

Finally, other workshops on accessibility and affectivity in higher education were held, including workshops on creating inclusive texts and presentations for and from the population with disabilities.

5. RESULTS

The development of the ENECI concept was the result of a collaborative effort by student chapters who researched and discussed the best methods for teaching science, particularly optics, to individuals with disabilities. This mission requires a continuous convergence of knowledge, people, and experiences in science education. ENECI provides a safe space to create innovative educational materials and approaches that enable individuals with disabilities to fully participate in the study of optics and related fields. By doing so, it aims to promote greater equity and inclusivity in science education and empower individuals with disabilities to pursue their academic and professional goals with confidence. Fig. 1 shows the core organizing team of the event who was in charge of all the implementation of the ideas and the managing of finances, spaces and to keep a coherence of the event with the initial goals.



Figure 1. Organizing team of ENECI.

Adhering to the principle of "Nothing about us, without us," the initial step was to reach out to and engage with individuals with disabilities and professionals who work with this population in a participatory dialogue. Together, we identified the most appropriate strategies to pursue as a team and subsequently organized inclusive meetings that were open to the entire community. Fig. 2A illustrates the different types of disabilities of the advisors, leaders, and teachers who have contributed to ENECI's mission.

By involving individuals with disabilities from the outset, we aimed to ensure that their perspectives and needs were fully integrated into the development of our educational materials and approaches. This inclusive and collaborative approach not only strengthens our work but also promotes greater equity and empowerment for individuals with disabilities in science education. ENECI has worked to emphasize the significance of ensuring inclusive participation in education, research, and science outreach, identifying the obstacles that prevent people with disabilities from participating and moving forward in a variety of academic and scientific fields, and highlighting crucial actions that can foster equality, accessibility, and inclusion.

In the meetings, the attendance percentage of people with disabilities was of over 9%, see Fig. 2B. This is a very important achievement for the ENECI team, since the participation of communities with disabilities shows that this initiative is reaching communities that have been marginalized in society for years. However, the representation of disabilities at the meetings extended beyond those that are more commonly recognized, such as autism, motor, multiple, and cognitive disabilities (as shown in Fig. 2C). Within this 9%, disabilities that are very prevalent in Colombian society, such as visual and hearing disabilities, were expected to be the majority.

Additionally, 38.8% of the attendees had prior experience with inclusion, which highlights the recent efforts in Latin America and Colombia to promote inclusion (see Fig. 3). Every day, more and more emphasis is placed on the process of increasing the opportunity and dignity of marginalized individuals so that they can engage in social contexts. It is particularly significant that women participating in the event made up to 59.3% of the total number of attendees.

The professional backgrounds of students from various educational levels, in particular: teachers, and researchers stand out among the attendees (see Fig. 4A) who expressed concerns about the need to consolidate strategies that promote the inclusion of people with disabilities in fields such as optics, astronomy, natural sciences, and education. Education, in particular, was seen as the most pertinent field for promoting greater inclusivity for individuals with disabilities in the community (see Fig. 4B).

Among the most frequently expressed demands were for educators to "adopt new awareness techniques for the organization and elaboration of pedagogical material in science for deaf and blind people" and "to strengthen the science projects (e.g. inclusive astronomy) that they develop in their institutions." Thanks to the discussions held during the meetings, many of these expectations were successfully met.

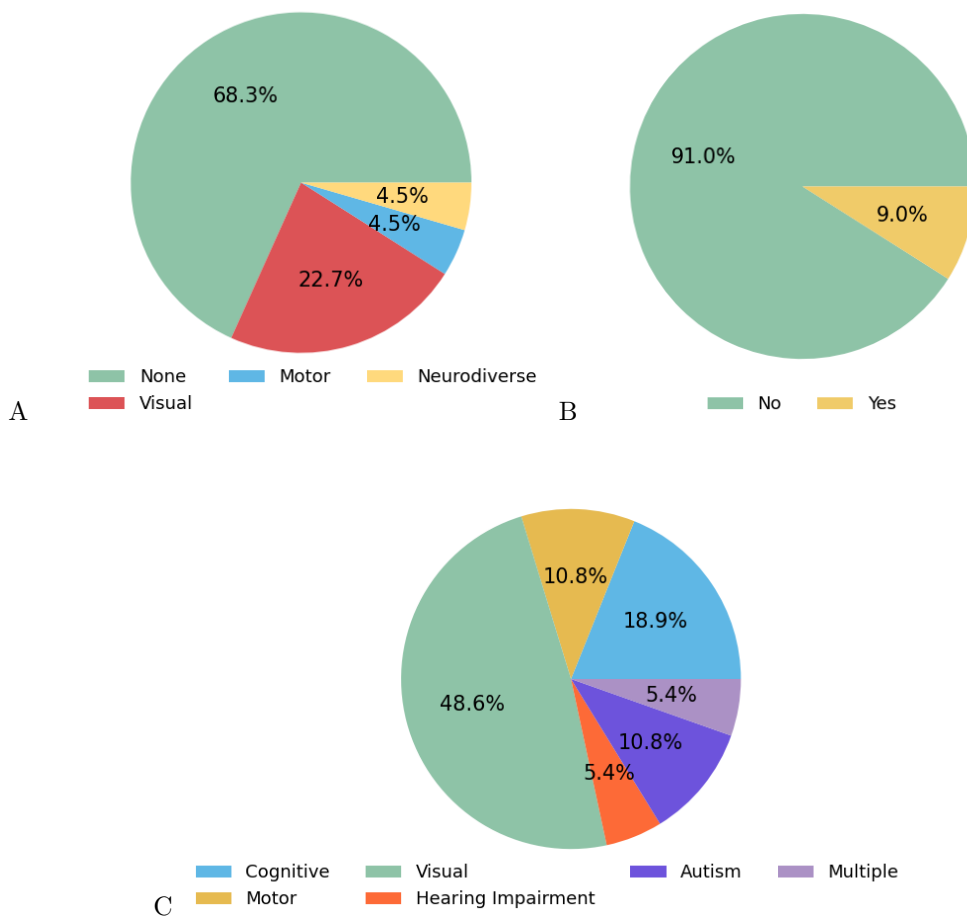


Figure 2. Percentage of ENECI assistants and collaborators with disabilities.

People from many nations, including Colombia, Chile, Spain, Mexico, the United States, Puerto Rico, Guatemala, Uruguay, Venezuela, El Salvador, Austria, China, and Italy, have participated in ENECI's implementation of the aforementioned initiatives. Colombia has the greatest participation rate, followed by Mexico, Spain, and the United States, as seen in Table 1.

One of the most relevant contributions in the field of education was made by PhD Diana Gil Chávez and PhD Dora Inés Caderón from the Francisco Jose de Caldas District University in Colombia, by highlighting the importance of training teachers and students to embrace diversity in basic, middle, and higher education institutions. Academic and personal training provide the necessary tools and knowledge to work with children and young people from a new perspective on education, giving them the opportunity to enhance their social and intellectual skills. The idea is that the classroom becomes a space where values and learning converge, where diversity is understood as an opportunity to recognize difference and practice the exercise of alterity, strengthening the sense of dignity and self-esteem. It is also important to implement pedagogical models and didactic techniques that promote multisensory experiences that meet the educational needs of all students.

In the field of astronomy, Beatriz García, an astronomer and researcher at CONICET in Argentina, made a valuable contribution was made in highlighting one of the greatest challenges in teaching astronomy to people with visual, hearing, and neurodiverse disabilities. It was noted that there is a lack of signs with scientific terminology in the deaf community, which presents a significant barrier to learning about astronomy. Moreover, as astronomy is primarily a visual science, it poses additional challenges for people with visual impairments. These insights

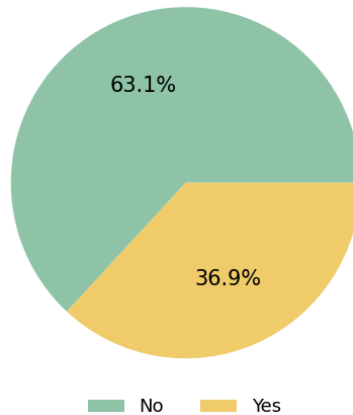


Figure 3. Percentage of inclusion experience of ENECI attendees

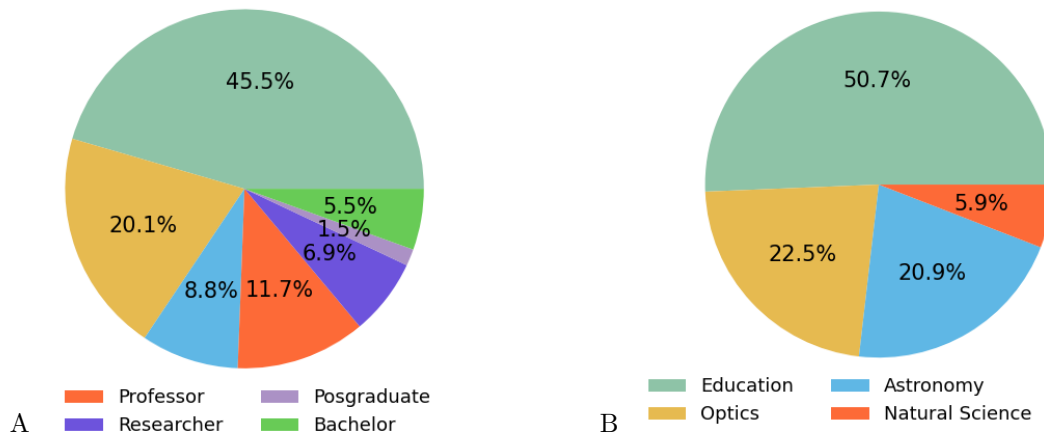


Figure 4. Profile of attendees and areas of interest.

emphasized the need for innovative approaches and inclusive strategies to make astronomy accessible to people with diverse abilities. To address this problem, she proposes the adoption of a multimodal perspective that takes into account the diversity of identities and abilities, which would make the sky accessible to all people. Some of the research projects she shared included the design of a prototype in 3D printing and braille, which simulates the sky with its stars and constellations to show how they move in their trajectory. She highlighted the possibility of making various adaptations to transform resources that were originally intended for people who are sighted, into resources that can be used by people with visual impairments. Additionally, a global encyclopedic dictionary of astronomical terms in sign language is currently being developed, taking into account that sign language varies from one country to another.

In the same vein, we would like to highlight the work of Wanda Díaz Merced, an astronomer from Puerto Rico who is a prominent advocate for equal access to astronomy. Among her research endeavors is the creation of a sonification prototype for studying astrophysical data. This prototype translates colors into sounds and haptic movements, providing a new perspective for the inclusion of enthusiasts and researchers with visual disabilities who seek to contribute to the field. This proposal is not only a complement to conventional visualization techniques but also an innovative way to promote inclusivity and accessibility.

We also invited to the conversation a large group of early career professionals, among them some Hispanic

Countries	% participating
Colombia	81.9
Mexico	9.8
USA	1.8
Spain	1.8
Chile	0.8
Argentina	0.8
Uruguay	0.5
Venezuela	0.3
Ecuador	0.3
Brazil	0.3
El Salvador	0.3
Guatemala	0.3
Puerto Rico	0.3
Germany	0.3
Italy	0.3
Austria	0.3
China	0.3

Table 1. Percentage of Participating Countries in ENECI

OPTICA Ambassadors. In particular, Dr. Maria Vinas-Pena was always supportive of this initiative and helped by giving talks but also ideas to transcend the frontiers of nations and languages to affect broader communities.

The workshop "Science is felt" was led by PhD Ana Karen Reyes from Mexico and grad student Edgar Santiago Reyes from the Center for Research in Optics CIO, and was aimed at students between 8 and 12 years old from the República de China school in Bogotá, Colombia, among whom were children with visual, motor, intellectual and autism disabilities (Fig 5 A). Through optics experiments, discovery-based learning, and multisensory experiences in the classroom, it was possible to observe the children's great curiosity to acquire knowledge and a strong motivation to propose solutions to the problems presented. The workshop participants were persistent and managed to perform the experiments, although some required greater support since it was their first time engaging in an activity of this nature.



Figure 5. Students doing the workshop "The science is felt."

In Fig. 5B, a student can be seen conducting two experiments to identify the sinusoidal shape of a wave, as well as constructing a homemade telephone to explain the difference between mechanical and electromagnetic waves.

The basic Braille workshop "It's time to learn to be inclusive" allowed the ENECI team and all participants to share with individuals with visual and low vision disabilities, such as children who are learning the language and their families, providing important support in this process (see Fig. 6A). It was also a useful tool for people who are progressively losing their sight and need to learn the language for their near future. Additionally, it allowed primary and high school teachers to learn the basic elements required to work and support their students with disabilities, mainly in areas such as physics, mathematics, biology, and social sciences. Finally, it was an excellent input for university students who are developing pedagogical products and projects for people with disabilities (see Fig. 6B).

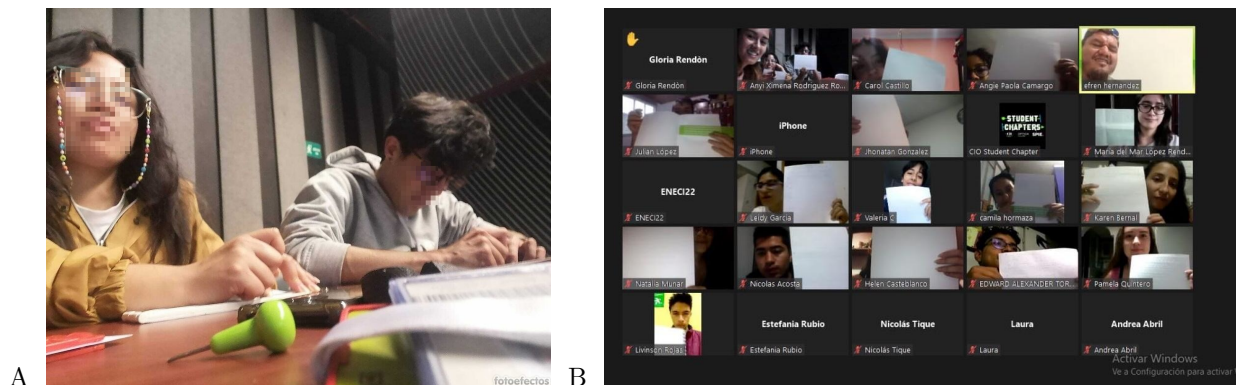


Figure 6. Participants in the Braille workshop.

The poster session presented at ENECI showcased an array of innovative proposals aimed at bridging the gap between science and populations with disabilities. Among the highlights were proposals from the fields of engineering and chemistry that engaged different senses in novel ways (Fig. 7), demonstrating the power of science and pedagogy to address the unique challenges facing these populations. These proposals represented a critical step forward in the efforts to expand the advancement of science to and alongside populations with more diverse capacities, backgrounds, and experiences. By utilizing creative approaches and thinking outside the box, these projects offer new possibilities for communication and understanding, highlighting the importance of collaborative efforts to address pressing societal issues. Overall, the poster session provided a glimpse into the exciting possibilities that lie ahead for the field of inclusive science and education, and underscored the need for continued efforts to promote equality, accessibility, and inclusion for all.



Figure 7. Poster session of work carried out in inclusion.

6. CONCLUSIONS AND PERSPECTIVES

After several years of collaborative work, ENECI has highlighted the significance of promoting inclusivity and accessibility in science education and outreach for individuals with disabilities. The insights gained from the participation of individuals with diverse backgrounds and experiences, including those with disabilities and those who work with people with disabilities, have emphasized the importance of offering immediate solutions to pressing societal issues.

ENECI aims to develop educational materials and approaches that enable individuals with disabilities to fully participate in the study of optics and related fields. One of the team's objectives is to create a didactic kit for teaching physical principles related to optics, which could be particularly beneficial for children and young people with disabilities, who could be inspired to pursue a career in science.

Moreover, ENECI recognizes the need to reach isolated and disadvantaged populations in Colombia and beyond. To achieve this, the team is actively collaborating to develop global encyclopedic dictionaries of astronomical terms in sign language and other adaptations to make science more accessible to individuals with diverse abilities.

In conclusion, ENECI's collaborative efforts have emphasized the importance of promoting inclusivity and accessibility in science education and outreach. The team's continued efforts to develop educational materials and approaches for individuals with disabilities are essential for promoting greater equity and inclusion in science education and for empowering individuals with disabilities to pursue their academic and professional goals and aims to expand these initiatives and the dialogue to other countries and languages.

7. ACKNOWLEDGMENTS

Throughout the trajectory of ENECI, national and international collaborators have joined forces, whose contributions have been fundamental to the construction of this project. Among them, the participation of the members and former members of the GOMa student chapters of the Francisco José de Caldas District University, the CIOR of the Technological University of Pereira, and the CIO of the Center for Research in Optics A.C. of Mexico stand out. We would also like to acknowledge the contributions of all the speakers and workshop facilitators who believed in this project and shared their work and experiences in inclusion, as well as the Transversal Academic Project for Teacher Training for Special Educational Needs Populations at the Francisco José de Caldas District University (NEEIS), the Bogota Planetarium, the Dado: design for all company (<https://dado.com.co/>) and the international optics societies IEEE (<https://www.ieee.org/>), OPTICA (<https://www.optica.org/en-us/home/>) and SPIE (<https://spie.org/?SSO=1>).

8. REFERENCES

- [1] Perry Zurn, Joseph Stramondo, Joel Michael Reynolds, Dani S. Bassett, "Expanding Diversity, Equity, and Inclusion to Disability: Opportunities for Biological Psychiatry". Volume 7, Issue 12, 2022, Pages 1280-1288, ISSN 2451-9022. Available: <https://doi.org/10.1016/j.bpsc.2022.08.008>.
- [2] United Nations, 2015, "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all", [online]. Available: <https://sdgs.un.org/topics/education>
- [3] DANE, Washington Group on Dissabilities, 2020, "People with dissabilities", [online]. Available: <https://www.washingtongroup-disability.com/fileadmin/uploads/wg/Documents/20-3d.pdf>
- [4] Ministerio de Educación Nacional (2022), "Inclusión y equidad: hacia la construcción de una política de Educación inclusiva para Colombia". Available: https://www.mineducacion.gov.co/1780/articles-363488_recurso_17.pdf.
- [5] C.Crosso, "The right to education of persons with disabilities: promoting the concept of inclusive education", Available: <http://www.rinace.net/rlei/numeros/vol4-num2/art4.pdf>
- [6] Y. Rodríguez, "Las personas con discapacidad en los objetivos de desarrollo sostenible", in Seguridad Social para el Bienestar CISS, pp. 7-111, 2020. Available: <https://ciss-bienestar.org/wpcontent/uploads/2020/12/Las-personas-con-discapacidad-en-los-objetivos-de-desarrollo-sostenible.pdf.pdf>

[7] L.A. Castro, "Política educativa colombiana frente a la inclusión. Un recorrido desde la Constitución política hasta la normatividad vigente", pp. 778-784, 2018. Available: https://repositorio.uptc.edu.co/bitstream/handle/001/6060/politica_educativa_colombiana.pdf?sequence=1&isAllowed=y

[8] A. Padilla, "Inclusive Education of Persons with Disabilities", rev.colomb.psiquiatr, [online]. 2011, vol.40, n.4, pp.670-699. ISSN 0034-7450. Available: http://www.scielo.org.co/scielo.php?pid=S003474502011000400007&script=sci_abstract

[9] National Development Plan 2018-2022 "Pact for Colombia, pact for equity". National Development Plan 2022-2026 "Colombia world power of life", Congress of Colombia, National Republic of Colombia. Available: <https://doi.org/10.18601/01245996.v22n43.09>