Communities for Sciences

WHITE BOOK

on Inclusive Science Education

Towards promoting an inclusive approach in science education

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No.872104

Imprint

The White Book on Inclusive Science Education was created by the C4S Consortium

RCE Vienna / Vienna University of Economics and Business I Undacio Universitaria del Bages I Universita`degli Studi die Milano-Bicocca I Erasmushogeschool Brussel I Galileo Progetti Nonprofit KFT I IB Gesellschaft für Interdisziplinäre Studien gGmbH I Lunds Universitet I New Bulgarian University

Main Authors: Irene Glockengießer, Gabriel Lemkow Tovias
Authors: Petar Lefterov, Marleen Rosiers, Sarah Scheer, Claudia Piovano, Anna-Maria Krulis, Martin Wildenberg, Lluïsa Sort García, Kristina Orban, Antoaneta Mateeva

Design & Layout: Irene Glockengießer / transformation.design

ACKNOWLEDGEMENTS

The process of composing this White Book was supported by professionals and members of communities from various European countries, sharing their perspectives and experiences on Inclusive Science Education. Thanks to the contributions and feedback of the following individuals, who have given us insights, advice, and recommendations, we are able to present this comprehensive publication. We would also like to thank all those who have inspired, challenged and strengthened us in the process of developing this White Book.

Carlo Antonini, Associate Professor, Department of Materials Science, University of Milano-Bicocca, Italy

Zino Boisdenghien, STEM Expert, Universitaire Associate Brussel, Belgium

Imma Casas Argerich, STEAMcat Innovation Program Ambassador, Education Department, Generalitat de Catalunya (Catalan Government), Spain

Xavier Gironés Garcia, Coordinator of the Central Catalonia Knowledge Region (Directorate General of Knowledge Transfer and Knowledge Society) Department of Research and Universities, Generalitat de Catalunya (Catalan Government), Spain

Mercè Requena García, STEAMcat Innovation Program Coordinator, Education Department, Generalitat de Catalunya (Catalan Government), Spain

Markus Hall, Dialog Marketing, Leopoldmuseum Vienna, Austria

Anja Hopstätter, Head of and teacher at an Elementary School in Mönchengladbach, Germany

Feri Janoska, Chairman, project manager and teacher, Roma Adult Education Center Burgenland = Roma VHS, Austria

Milena Leneva, Co-founder and CEO of Tempo Foundation, Bulgaria

Andrea Eleonore Neuhauser, Elementary teacher in special and remedial education, City of Vienna & Student at the University of Agricultural and Environmental Pedagogy, Austria

Monica Chiara Onida, Ph.D in Geological Science, Contract professor at the Department of Environmental Sciences and Human Sciences for Education at the University of Milan-Bicocca, Italy

Zehra Öz, Primary school teacher & Lecturer in Media Arts, Belgium

Markus Rumelhart, District Head in the 6th District of Vienna, City of Vienna, Austria

Savka Savova, Psychologist & Methodologist, Health and Social Development Foundation, Bulgaria

Martin Scheuch, Professor for Biology Education, University College for Agricultural and Environmental Education, Austria

Mona Scherz, Community councillor for environmental issues, Municipality of Natschbach-Loipersbach, Austria

Martin Sharman, Policy officer for DG RTD, European Commission (retired)

Christina Siry, Professor of Learning and Instruction, The University of Luxembourg, Luxembourg

Sven, Pilot teacher Brussels Hub, Belgium

Carolina Trcka-Rojas, Biologist & Science Educator, Austria

TO LISTEN

What little Momo could do like no one else was: Listening. This is nothing special,some readers will say, everyone can listen. But this is a mistake. Very few people can really listen. And the way Momo knew how to listen, it was completely unique. Momo could listen so well that stupid people suddenly had very clever thoughts. Not because she said something or asked what gave the other person such thoughts, no, she just sat there and just listened, with all the attention and all the sympathy. As she did so, she looked at the other with her large, dark eyes, and the person in question felt thoughts arise in him that he had never known were inside him. She could listen in such a way that perplexed or indecisive people suddenly knew exactly what they wanted. Or that shy people suddenly felt free and courageous. Or that the unhappy and depressed become confident and happy. And if someone thought his life was utterly wrong and meaningless and he himself was just one of the millions, one who doesn't matter and who can be replaced as quickly as a broken pot - and he went and told all this to little Momo. Then, while he was talking, he realized in a mysterious way that he was utterly mistaken, that he, just like her, existed only once among all people and that he was therefore important to the world in his own special way. So, Momo could listen!

MOMO, Michael Ende, 1974

TABLE OF CONTENTS

GLOSSARY

COMMUNITIES IN VULNERABILITY RISK SITUATION:
In different social contexts, particular social groups may be more susceptible to certain types of risks, such as social exclusion or segregation, becoming invisible in certain contexts. Their demands and needs often go unrecognized by most of the population. Examples of communities at risk include migrants or refugees, individuals with physical or mental disabilities, or members of the Roma community, among others.

COMMUNITY LIVING LAB (CLL):
A Community Living Lab is a site, either indoors or outdoors, that is open to local communities and the social and natural environment. It serves as a space in which children and youth can conduct research and investigations toward common goals and initiatives. CLLs can evolve and incorporate new materials, tools, sites, or social actors based on the interests and initiatives of the participants.

HUB:
A Hub is a local node that connects various institutions, social actors, CLLs and other resources to promote actions focused on inclusive science education activities or initiatives.

INCLUSIVE SCIENCE EDUCATION (ISE):
Science plays a significant role in our current society by providing innovative solutions, explanations and technologies and by addressing social needs. However, as a social practice, science (including science institutions, scientists, science education activities, and scientific research) often incorporates or reproduces prevailing social values in the society with which it is associated, such as sexism, racism, colonialism, or ableism. Inclusive Science Education aims to address these issues by actively promoting non-exclusionary practices in science and by identifying and providing guidance on fostering a more inclusive approach to science and science educational activities and initiatives for all communities.

INTERSECTIONALITY:
Intersectionality is a critical theory used to identify intersecting determinants, including, but not limited to, gender, age, disability, education, and ethnicity that can contribute to inequality and marginalization. To promote inclusive science education, intersectionality is a helpful theory for reflection on issues of inequality at all levels.

PILOT ACTIVITIES:
These activities refer to the actions performed within the CLLs during the data collection phase of the pilot period. Gathering observations and data during this phase does not preclude conducting previous activities in the CLLs to test the validity of materials or engage children in the CLLs based on their interests.

PILOT SITE:
Each Hub should select at least one CLL as a pilot site for data gathering and observation during the data gathering process described above. Observed events may occur either within or outside the CLL premises, including activities such as excursions or study visits. Other local CLLs may also participate in Hub activities without the need to gather data for research purposes.

RESPONSIBLE RESEARCH AND INNOVATION (RRI):
Responsible Research and Innovation (RRI) is an approach that anticipates and assesses potential implications and societal expectations regarding research and innovation. Its aim is to promote the design of inclusive and sustainable research and innovation. The main dimensions of RRI that arise in our research are governance, ethics, gender, public engagement, open access and science education.

STEAM:
This acronym stands for Science, Technology, Engineering, Arts, and Mathematics and signifies a dynamic and interdisciplinary approach to education and problem-solving. It is frequently used in interdisciplinary presentations or approaches that combine two of more of these disciplines through actvities that cross the boundaries between them.

EXECUTIVE SUMMARY

This report presents a comprehensive set of recommendations and guidelines on the conceptualization, applicability, implementation, and impact of inclusive science education.

This document has been developed to provide practical resources to policymakers, institutional representatives, and educators, by offering a diverse range of examples and recommendations at various levels to support the implementation and enhancement of ISE.

The White Book is founded on the theoretical framework of ISE developed throughout the *Communities for Sciences (C4S) Towards Promoting an Inclusive Approach in Science education* project. It is based on an extensive analysis of previous initiatives, European Union (EU) projects in this field, and insights gained from various C4S workshops and working groups. These forums, conducted both online and offline, facilitated discussions on ISE matters with experts and members from different target communities such as Roma, migrants, people with disabilities, LGBTQ+, diverse gender identities, and women scientists. Moreover, it incorporates the outcomes derived from the pilot activities carried out in eight EU countries. All these activities provided a solid foundation for the recommendations delineated below.

However, it is crucial to emphasize that this White Book is an integral part of an ongoing coconstruction and coparticipation process in which the C4S project represents only one of numerous significant social actors. Consequently, this document does not aim to provide a rigid set of instructions accompanied by strict roadmaps. Instead, it offers adaptable heuristics that must be customized to fit specific situations, thus remaining open to discussion and deviations from the original ideas. Moreover, to ensure the robustness of these recommendations, a thorough review process has been conducted that involved collaboration with members of the participant communities as well as institutional representatives, policymakers, and members of the C4S Advisory Board who contributed their ideas, insights, and feedback to both the original document and its recommendations.

INTRODUCTION

This White Book aims to **provide practical guidelines and orientations for promoting inclusivity in science education.** It is designed to be used by policymakers, representatives of institutions, educators, teachers, researchers, and other relevant stakeholders. The recommendations in this White Book are organized according to specific audiences, with separate chapters for each: policymakers, practitioners and communities. **It is intended to be applicable to policymakers at both the international and national levels, serving as a valuable resource for educators, teachers, and other multipliers, also addressing community members. In this manner, users can readily access the sections most pertinent to their needs and interests. It is important to note that all levels are intricately linked and interconnected.** It is informed by the experiences and insights gained from the Horizon 2020 project *Communities for Sciences (C4S)*, a three-year initiative aimed at promoting inclusivity in science education at a European level. The project specifically focused on communities in vulnerable risk situations, including Roma communities, migrant communities, persons with disabilities, women scientists, and individuals with diverse gender identities, by adopting an intersectional perspective. Although the experiences within these communities form the foundation of this White Book, the findings and recommendations have been generalized to apply to implementing positive practices in other communities, such as the LGBTQ+ community or refugees.

Lastly, it is important to acknowledge that **this White Book is part of broader efforts to promote a more inclusive society and actively combat all forms of discrimination and social injustice.** Although it represents a step in the right direction, **we recognize there is much more work to be done**, not only at the three levels we describe in this document, but also in terms of self-awareness within our institutions, including those forming the C4S Consortium.

The journey towards inclusion is an ongoing one, but one that we believe is worth pursuing. Therefore the following pages will provide the rationale and context for this initiative. The content is structured according to specific intervention levels, with each section offering useful examples and reflections to enhance understanding and facilitate the implementation of recommendations.

RATIONALE AND CONTEXT

The societies of 21st-century Europe are characterized by their diversity, mobility, and ongoing changes resulting from significant crises such as the 2008 economic and EU governance crises, the COVID-19 pandemic and the escalating crises of climate change and biodiversity loss.

Crises often bring about periods of instability and, unfortunately, can also foster xenophobia, aporophobia, and tendencies toward uniformitarian views of societies. Vulnerable communities, including migrants, refugees, minorities, people with disabilities, women, as well people with different gender identities, are particularly affected by current crises, such as pandemics, the climate crisis accompanied by the sixth mass extinction and, of course, great social injustices within our society. Facing accusations of spreading diseases, exclusion from priority health policies and misinformation campaigns, members of these groups are also more likely to drop out of school. Even more specifically, women and gender diverse persons encounter restricted access to services, increased vulnerability to sexual abuse, gender-based violence, and the perpetuation of oppressive gender roles.

The C4S project is driven by the awareness of these threats faced by communities in vulnerability risk situations. It aims to have a significant impact and create change in contexts with special difficulties, including those in which crises have past but injustices and exclusion persist. The second rationale of the C4S project, and consequently of this White Book, is the recognition that education, particularly in science and STEAM fields, is of utmost importance, especially because a more diverse science is also a better science, and that endorsing diversity in education both as unavoidable and as inevitably enriching for schooling systems promote a better and more cohesive and prosperous society. **In a period marked by climate change, the COVID-19 pandemic, and the emergence of new technologies with ambiguous uses, a well-informed and scientifically literate society can make a difference in addressing local and global risks and phenomena.** Crises often coincide with social discrimination and critical decisions for the future.

Science activities, discoveries, dissemination and education do not exist in abstract realms but are carried out by specific individuals and institutions with their own beliefs, dynamics, and interactions. **Science is a cultural practice shaped by cultural agents who, all too often, unintentionally introduce non-scientific elements into their work.** Examples include science books or exhibitions that exclude women scientists, depictions of human evolution that present a linear progression from an ape to a white man without disabilities, or research practices in which local informants from developing countries contribute valuable scientific knowledge but are not acknowledged as co-authors or beneficiaries of discoveries. **This, not only has an impact on the type of knowledge we receive and disseminate but also on the quality of this knowledge and on the implied segregation it has for many communities whose contributions to science and human knowledge in general become systematically invisible in our textbooks, documentaries, and scientific practices in pedagogical institutions.** If we want to promote a sense of belonging within schools for all children, especially migrant children and girls, we should start by reviewing the type and the quality of knowledge that is presented in pedagogical sites. **Furthermore, the striving toward inclusion should be a never-ending process involving not only educators and pedagogical services but also policymakers and legislators in their aim to legislate for a more fair and equitable society.**

The factors required for a more inclusive education and for science education, which is our specific focus here, necessitate an urgent reassessment of certain science educational practices that unintentionally transmit biased messages and reproduce invisible or even physical barriers. **Science holds significant social authority today and, as such, must be critically examined to identify and challenge biased ideas,** such as sociobiological reductionist theories or documentaries with gender biases. **Not all practices can be accepted in the name of science, especially those that perpetuate sexism, xenophobia, ableism, and other forms of bias.** Educators, institutional representatives, policymakers, children, and families should be educated on these issues to address biased practices and promote more inclusive approaches. **Science can then act as a cocreator of a communitarian and fairer society.**

THE C4S HUBS

This white book represents varying degrees of collaboration of policymakers, practitioners, and community members in researching topics of common interrest. All recommendations are drawn from information obtained in the local C4S Hubs after working with communities, schools, and policymakers. These Hubs, with their pilots, play the central role in advancingthe C4S initiative to work together to effect meaningful change to achieve inclusive and equitable science education.

OVERVIEW

BUDAPEST

- The Budapest hub, led by Galileo Progetti Nonprofit Ltd, collaborates with the association of public nurseries in the VIII district of Budapest, Józsefvárosi Egyesített Bölcsődék (JEB). The Mini-Manó nursery hosts the EDU_LAB 0_6, a space equipped to facilitate inclusive science education in early childhood education and care.
- This district is particularly multicultural and has a high percentage of residents from the Roma minority. The target group of the hub includes all children and families in the district that face socio-economic vulnerability, with a special focus on inclusion of the Roma population.
- The EDU_LAB 0-6 center, that includes also teachers with Roma Bachground, was designed and set up during the pilot in spaces provided by the Municipality. It is open for Children from district nursery schools and families on Saturday afternoons. Considering the distrust of many local families towards institutions, the educators conducted activities outdoors, in public parks during local events organized by the municipality and the Sure Start Children's House.

BRUSSELS

- The hub is an integral part of the teacher training program at EhB. The Wonderlab, a space and concept for playful science education, serves as the CLL for the hub and will remain active with students, practitioners and families.
- As Brussels is a super-diverse city, the participants in the Brussels science activities primarily come from migrant communities, including newcomers and second and third-generation individuals.
- The pilot project involved collaboration with a local school. A student and preschool teacher co-created science activities as part of an embedded internship project. Children shared their experiences with their families.

MANRESA

- The Hub focuses its pedagogical work in the river area outside Valldaura Public School. This river area functions as a community living lab (CLL) and will continue to operate as the main CLL for this school. A main project was a book created by the children participating in this CLL, which will be available for all schools in Manresa to visit the river area and explore its scientific possibilities.
- In our pilot, we worked with children and educators from a public school in Manresa with a significant number of migrant families and children.
- The pilot involved weekly visits to a riverside location for science activities, as well as reappropriating the space for the neighbourhood families. Some activities were also conducted in the classroom or in the Lab 0_6 at FUB University to reinforce and extend the experiences from the riverside visits.

MILAN

- The Milano hub, led by the University of Milano-Bicocca and GiocheriaLaboratori, engages with infant schools in the Municipality of Milano. The hub focuses on promoting inclusivity in science through teacher training programs.
- The Milano hub works with children with special educational needs or disabilities, providing teacher training in inclusive science education. External experts from the target community are involved, and efforts are made to narrow the gender gap by including female scientists.
- During the two pilots, children and practitioners participated in two workshops—one on the topic of the circle of life of trees and the other on physics. Natural and recycled materials were utilized in both pilots.

SOFIA

- C4S Sofia Hub operates three community living labs (CLLs) led by New Bulgarian University (NBU) and located in the alternative kindergartens of the Health and Social Development Foundation (HESED) for preschool Roma children in the Faculteta neighborhood in Sofia.
- The C4S Sofia Hub exclusively works with Roma children in the Roma community. The CLLs involve 3- and 4-year-old children from HESED's centers, namely MIR Papanchev and MIR Shuhodolska.
- The pilot took place at HESED's centers, with the participation of children and teachers. The team aimed to stimulate the development and inclusion of Roma children by bridging the gap between science and their education. Active engagement of children in science activities aligned with the state-approved curriculum was promoted through child participation approaches and the provision of scientific didactic materials.

VIENNA

- This hub, located in a school garden in the 20th district of Vienna, serves as a community living lab (CLL) and the concept is designed to continue in adapted versions post-C4S. We therefore developed freely accessible learning materials and provide concepts for school workshops and invite others to conduct similar projects.
- In our pilot, we collaborate with children from migrant backgrounds and senior citizens in a community garden to promote inclusive science education and break down barriers and bias.
- The pilot project consisted of a series of workshops developed in collaboration with an elementary school. The workshops focused on natural sciences and key social skills, as well as the design of accompanying learning materials in the spirit of education for sustainable development.

One of the **main goals of these centers is to bridge the gap between science and society**, a gap in which the full range of all active social actors often goes unrecognised. **HUBS design and implement science education activities in both formal and non-formal educational settings with the goal of emphasizing the promotion of scientific awareness and diverse scientific skills in communities.** Equal importance is also given to raising community members' awareness of exclusionary practices in the field of science and participating in efforts to counteract them. Crucially, these **HUBs facilitate collaboration and co-creation of policies with science experts from the communities themselves.** These community members serve as alternative role models in the world of science, providing valuable inspiration and guidance and expanding the horizons of a very Eurocentric scientific world.

We, as a Consortium, are part of a very privileged group, and it is also up to us to critically examine our own roles and to reflect on institutionalized barriers that we ourselves have grown up with. Breaking through our own patterns is a most difficult task, but it is the cornerstone for a new way of working together.

CONTEMPORARY CHALLENGES

Resources & Reform: what is needed on a Structural Level?

Our failures to create cohesive societies has negatively affected the lives of countless people. Education empowers individuals and provides them a means to address the emerging issues in our society. The vision of inclusive education, in which every individual has access to high-quality learning experiences, resulting in greater future diversity, is not new. The findings of early alternatives, the reform pedagogy of the 1970s, educational and scientific studies, brain research, and experiments have shown us for many years that educational systems should be adapted and made more user-friendly. Instead, **barriers are still being erected that block access to education by people from low-income backgrounds, members of ethnic minorities, persons with disabilities, and marginalized communities. These barriers perpetuate inequality and impede upward mobility.**

Inclusive societies strive to ensure that everyone has fair access to employment, living wages and economic opportunities. **When inclusion is not persued, or when efforts, fail, inequality becomes more pronounced. In such situations, certain groups almost invariably encounter barriers to employment, career advancement, and financial stability.** This results in wealth disparities, discrimination, and prejudice based on factors such as ethnicity, visual appearance, gender, sexual orientation, religion, and disability, that affect every aspect of the lives of those affected. Marginalized groups face systemic barriers, bias, and unequal treatment across various domains, including employment, housing, healthcare, and the justice system.

In examining the role of policymakers, it becomes obvious that they often use the terms integration and inclusion interchangeably. These terms need to be defined at the outset and their meanings internalized. **Allthough integration means fitting into an existing group, accepting its values and culture unquestioningly, inclusion aims for holistic coexistence. In an inclusive society, differences contribute invaluable richness through mutual exchange.** An existing network can be greatly enriched by diverse and perhaps initially unfamiliar and unconventional ideas or practices, strengthening not only the social fabric but also individuals. The assertion „Everyone can do something!" is only partially correct at a structural level.

People who would like to work but are legally prohibited from doing so because of certain regulations are confronted with a huge barrier that is neither integrative nor inclusive. Just changing such laws would bring about a wave of positive developments. When people work in companies and establish social contacts, learning a language becomes much easier than learning it in classes. Taking responsibility for work processes is an underestimated form of empowerment and significantly boosts self-esteem for many people.

Access to critical services and resources is an important chapter in the history of exclusion. Inclusive societies strive to ensure that vital resources such as health care, social support, transportation, and affordable housing are accessible to all people regardless of their backgrounds or circumstances. Re-presentation, or rather the lack thereof, paints a vivid picture especially when it comes to education. When people are denied, restricted, or hindered in their education, society is also deprived of important learnings and expanded solution-oriented strategies. The absence of inclusion means that marginalized groups are severely underrepresented in positions of influence and remain so today. Their voices go unheard, their needs unaddressed, and their perspectives unrecognized, perpetuating a cycle of exclusion.

Inclusion often exists only on paper to meet imposed quotas. Policymakers and legislators, along with other social actors and members of communities, have a responsibility for systemic change. Reassessing the situation and implementing realistic measures to reduce barriers and emphasize diversity are in the hands of those who set the framework for our society.

One might think that inclusion is described as a never-ending process, which is of course true insofar as mindfulness in dealing with people and self-analysis and reflection are supposed to be repetitive processes. But inclusion also has a stated goal, which is achieved when the color of our skin is no longer tainted with judgment and stigma. When people with disabilities are no longer seen as „handycapped" and all of our differences are not only tolerated, but seen as abilities and natural. Only when we no longer have to think and talk about inclusion will it be lived and become part of our social and cultural self-image.

HOW IS SCIENCE TAUGHT?
Didactics, Oversimplification & Eurocentric View

Science education often consists of a combination of lectures, hands-on laboratory-based experiments, and textbook readings. However, the way science is taught varies depending on the specific context and goals of the lesson. Alternative pedagogical approaches to science education have been proposed (from John Dewey's "learning through problems" approach to Freinet's techniques and Decroly's use of the natural environment to foster children's curiosity and other current approaches), with varying degrees of success. None of them have ever led to the abandonment of traditional, narrow, and selective (and thus exclusionary) approaches to science education.

One of the challenges in science education is to avoid oversimplification, which can occur when complex scientific concepts are reduced to overly simple explanations that do not capture the full complexity of the phenomena being studied. This can lead to a lack of understanding and appreciation for the intricacies of scientific inquiry. This oversimplification can occur from a number of misguided pedagogical approaches. Among them are explaining science from an analytical perspective, as if our knowledge is moving from simple to complex, to an atomistic approach in which various science curriculum topics are presented without making connections to each other or to children's interests, to explaining science in its experimental and/or mathematical aspects but ignoring other areas of science practice with other skills such as field trips, classification procedures, and curatorial practices.

Another challenge in teaching science, and science itself, is the Eurocentric perspective that dominates and forms the basis of curricula and teaching and literature. Eurocentrism refers to the tendency to view the world from a European perspective, often at the expense of other cultural perspectives. In science, this can manifest itself in a focus on European scientific achievements and a neglect of the contributions of scientists from other regions of the world.

The result of failing to deal with these challenges is a lack of diversity in scientific perspectives and the marginalization of contributions from scientists from underrepresented groups. Such an approach risks ignoring, neglecting, or even covering up the horrific colonial practices carried out by (or under the guise of) science such as slavery, plunder, misrepresentation of entire communities, or privatization of public goods. Another such risk is the racialization (including with negative connotations) of Roma or Black people, who are often still socially excluded based on neuromyths that attempt to link barriers to learning with lack of cognitive ability. And still another is the use of degrading and often overtly sexualized and exoticized images of people from less developed countries that are still used today as a means of science communication or for events (from science museums to science books to the media).

We must remember that sexism, racism, and ableism exist today also because many of our everyday situations are permeated by such biased representations of the "other". This includes biased representations at the institutional level and is reinforced by the authority with which science is communicated. To avoid such biases in science and address these challenges for ISE, science educators should develop a greater awareness of past biased practices. They should incorporate a variety of instructional strategies such as hands-on inquiry-based learning, problem-based learning, and project-based learning that encourage students to explore science concepts in depth and engage with diverse perspectives.

Exploring natural landscapes, participating in science exhibitions together, engaging children in identifying (and overcoming) obstacles and needs in their daily environments and neighborhoods, or discovering pluralistic references in science are also positive science initiatives that can enable children to better engage with different science domains. Responsive teaching practices that integrate diverse cultural perspectives and empowerment activities that give children real agency and the ability to incorporate social problems of a scientific nature into the curriculum need to be fostered. Instruction could ensure that all students have access to a rich and diverse understanding of scientific inquiry that reflects the broader global community.

OUR UNDERSTANDING
Science as a Critical Community Activity!

In addition to fostering collaboration, **critical and ISE emphasizes the greatest possible diversity of voices and active participation.** Science is not just the domain of experts and specialists; this ISE approach teaches science as a collaborative and inclusive process that incorporates multiple perspectives and values diverse contributions. **It recognizes that science can perpetuate inequality and injustice if not conducted in an ethical and socially responsible manner**. The importance of addressing issues such as power dynamics, marginalization, and privilege in scientific research is emphasized.

It is this inclusion of diversity in science education that helps to challenge the traditional power structures and knowledge hierarchies that have historically marginalized certain communities. There are members of so-called "vulnerable groups" in science and other fields, but they do not appear in professional practice because discrimination occurs. If discrimination is elimited, diverse perspectives, experiences, and knowledge systems can be recognised, honored, and integrated into scientific practices and findings. Creating opportunities for participation allows for more and different voices in scientific topics, methods used, and how science is used to solve real-world problems.

The prevailing view of science is often one-sided precisely because science has been reserved for hundrets of years as the province of white males. The problems associated with diversity of opinion and participation in science education are deeply rooted in structural inequalities. **Systemic bias, unequal access to resources, and exclusionary practices within scientific institutions are barriers that prevent diverse contributions and new access. These challenges must be addressed primarily at the structural level, and policymakers, educators, and institutions must act accordingly with the aim to redress the situation.**

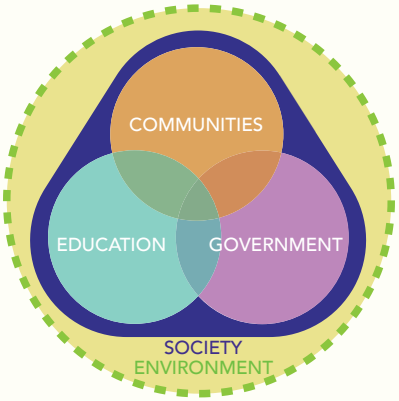
Science is often portrayed from a romanticized perspective as an individual, heroic process of discovery. **Although we acknowledge the contributions of individual scientists (e.g., Einstein, Marie Curie) to science, we must nevertheless emphasize that such contributions were possible thanks to the work of countless working teams around the world composed of scientists and experts with diverse, complementary skills.** This also leads to the idea that **we must similarly promote the idea of forming multicompetent groups in scientific work with children and young people in schools**.

Not all children act equally well in a particular aspect of science (e.g., math, experimental science, etc.), but plurality is when all children support scientific inquiry by using their personal strengths to enrich the team. Some may be very good at communication, some at leading teams, some at spotting anomalies through careful observations, and some may know where to look for new information or whom to ask for professional help through empathetic social interactions. They are equally important to the scientific research process!

To take full advantage of such opportunities, safe and supportive learning environments must be created that foster dialogue, respect, and sharing of diverse perspectives. This requires that teachers be trained in culturally sensitive pedagogy and also be open to learning from students and community members. Ongoing reflection and critical examination of biases, both individual and systemic, that can perpetuate exclusionary practices must be evaluated, adjusted, and developed through recurring processes. This not only enhances the quality and relevance of scientific research, but also contributes to a broader societal goal of social justice and equity.

ISE also encourages the use of culturally sensitive teaching practices and the integration of diverse perspectives and experiences into the curriculum and classroom. This helps students to see themselves and their communities in the scientific process and makes science more relevant and interesting for all students.

RECOMMENDATIONS
How this White Book works



In this section, we present a set of recommendations related to the promotion and implementation of ISE activities. These recommendations provide **a useful toolkit that expands the range of opportunities and mechanisms for raising awareness about promoting inclusion in science on three main levels.** The recommendations are summarized in the form of roadmaps including steps that need to be reflected to ensure ISE acts with and for communities. Therefore, we mention **Top Down/ Bottom-Up approaches** to show different possibilities for using the **roadmaps** in more participatory ways.

Our roadmaps are based on and grounded in case studies drawn either from the C4S pilots and/or further from experiences gained by the C4S Consortium. Although the following chapters are treated separately, both visually and verbally, in reality they are closely linked. For the sake of clarity, we will try to look at inclusion and diversity in all its facets from different points of view, but these points of view are interconnected. What is reflected in our project, our work, and our experiences is the thread that always leads to the structural level and the people who are responsible for social frameworks, educational systems, and laws.

Of course, everyone can and should act self-reflectively, but often all the self-reflection and intrinsic motivation is of no use if the framework conditions in everyday life leave no room for change and personal development.

TOP DOWN - BOTTOM UP

These approaches work best in combination to achieve a comprehensive and sustainable educational reform in science education. For example, policymakers and educational leaders can provide resources and support for local communities to implement innovative and culturally responsive curricula, while teachers and students provide feedback and input to guide the development of policies and practices at the upper levels of the educational system.

In a top-down approach, changes are mandated by policymakers and implemented from the highest levels of the educational system down to the local level. In this approach, policymakers and educational leaders set the goals, policies, and procedures for education, and teachers and students are expected to follow them. This approach can be effective when it comes to large-scale change but may not always address the needs and perspectives of teachers and students at the local level.

A bottom-up approach is initiated and implemented by teachers, students, and local communities, with support from policymakers and educational leaders. In this approach, teachers and students are actively involved in shaping educational goals, policies, and procedures, and the focus is on addressing the needs and perspectives of local communities. This is a good way to foster collaboration and stakeholder ownership but does not always lead to comprehensive change.

POLICYMAKERS

Recommendations for Policymakers on the Promotion and Impact of ISE

POLICIES FOR THE PROMOTION OF AN INCLUSIVE APPROACH

These guidelines aim to provide policymakers in Europe with practical recommendations for promoting a more inclusive society through ISE and social justice. Specifically, the guidelines target children and youth living in vulnerability risk situations, ensuring that they have equal opportunities to engage in quality science education and experience empowerment for lifelong learning. The guidelines are aligned with the existing EU guidelines for policymakers promoting inclusive communities for all.

To enable access and, more importantly, success in developing ISE, requires changes in the way policy issues are communicated and represented. Building strong coalitions and partnerships that make the voices of stakeholders and communities affected by policy decisions better heard is an existential point. Including diverse perspectives and ensuring that marginalized groups are included in the policymaking process is also essential to promoting inclusivity more broadly.

Awareness needs to be raised at the structural level to recognize the interdependence of policy issues and the need for holistic solutions that address multiple challenges simultaneously. Policymakers should take an integrated and collaborative approach to break down silos and build bridges between different sectors and stakeholders. Grassroots initiatives that promote inclusion have a solid foundation when they are supported by policymakers, and policies that are promoted from the top down carry more weight when they are based not only on abstract data, but also on real stories and voices from actual experiences of discrimination.

Commitments to continuous learning and improvement must be made, thus engaging policymakers and other stakeholders in ongoing dialogue and feedback loops to ensure that policies are effective and responsive to changing needs and contexts. By addressing these developments and upheavals, policymakers have the strongest role in developing inclusive, equitable, and sustainable policies that benefit all members of society.

INSIGHTS

Education is a cornerstone of society because it equips individuals with knowledge and critical thinking skills to address the complexity of the challenges ahead. To this end, accessibility to education should be assured for all learners, regardless of their backgrounds, skills, or identities. This chapter is a call to action for policymakers, at the international and national levels, urging them to prioritize and commit to implementing ISE. Diversity is not a barrier, but an asset that enriches the learning experience and promotes a more comprehensive understanding of scientific concepts.

VALUES AND POSSIBILITIES

Policymakers play a central role in shaping the educational landscape and driving systemic change. By introducing policies that promote ISE for all, and at the earliest possible stage, policymakers can create an environment in which every learner feels valued, supported, and empowered to engage with science questions. Similarly, policymakers can also provide teachers with appreciative and, above all, supportive working conditions. This chapter not only emphasizes the importance of ISE but also tries to shed light on the intersectionality behind it.

By developing and implementing comprehensive policies that prioritize inclusivity, equity and accessibility, policymakers lay the groundwork for transformative change. Recommendations for action already exist that provide a starting point for policy restructuring to support the implementation of ISE. Challenges and considerations are not limited to only one targeted group but are also relevant for other communities in vulnerable risk situations. Inclusive educational policies should aim to create a sustainable, positive, and inclusive learning environment for all groups so that they can fully realize their educational potential.

IN THE CASE OF INCLUSIVE EDUCATION THE FOLLOWING SUMMARIZED CHALLENGES ON A POLICY LEVEL WERE IDENTIFIED BY THE EUROPEAN UNION 2020 ON PROMOTING COMMON VALUES

- Policies must be developed and implemented that ensure a sustainable, positive, and inclusive learning environment. Doing so will allow young migrants to reach their full educational potential.
- In the educational process, young migrants and their families must be involved actively with focus on their resources for example, their social capital, the children`s first language and other capabilities, competencies, and qualifications, all of which can be ascertained through adequate assessments.
- Further, policies should seek to empower young migrants and refugees to undertake lifelong learning activities, including vocational education and higher education. In this context, the potential for digital learning and Information and Communication Technologies (ICT) should be acknowledged. In addition to their potential to address other educational needs, digital learning and ICT present opportunities to overcome educational gaps caused by such occurrences as the COVID-19 pandemic.
- In the case of young migrants and refugees, holistic approaches grounded in sound policies will strenghten their ability to cope with transition-related challenges.
- Gender- sensitive policies that promote an inclusive learning environment will promote societal integration and consideration of human rights. These kinds of policies foster improvement in sustainable educational outcomes without placing an unfair burden on schools, parents, or communities.

European Union 2020. Thematic fiche: Inclusion of young refugees and migrants through education. ET 2020 Working Group on promoting common values and inclusive education

TRANSFORMATION AND DESIGN

Education policy and training systems need to be rethought and reformed. We face challenges that require rethinking that produces new ways and new strategies. We need to cooperate and function as a society. Segregation, social gaps, and knowledge of shortcomings and failures at all educational levels do not really allow for the continuation of "tried and true" methods. They have not proven their worth. The results in the educational sector are alarming. Social gaps are widening, the health care system is at its limits in many places, and not only because of the consequences of the pandemic. New, innovative, and above all, sustainable ideas and practices are needed that can be implemented quickly.

Recognition, consideration, and inclusion of marginalized communities are crucial, especially in the educational process, with a focus on recognizing and using existing resources such as social capital, first-language knowledge, prior education, skills and qualifications.

Young people, families, people with disabilities, migrants, refugees and other marginalized groups, regardless of their gender identities, should be actively invited to participate in the process. To address future challenges, holistic approaches that implement well- grounded policies and incorporate support systems are needed. Gender sensitivity, promotion of social inclusion and addressing human rights should be integral components of inclusive educational policies. Implementing such policies can improve sustainable educational outcomes without overburdening schools, parents, or communities.

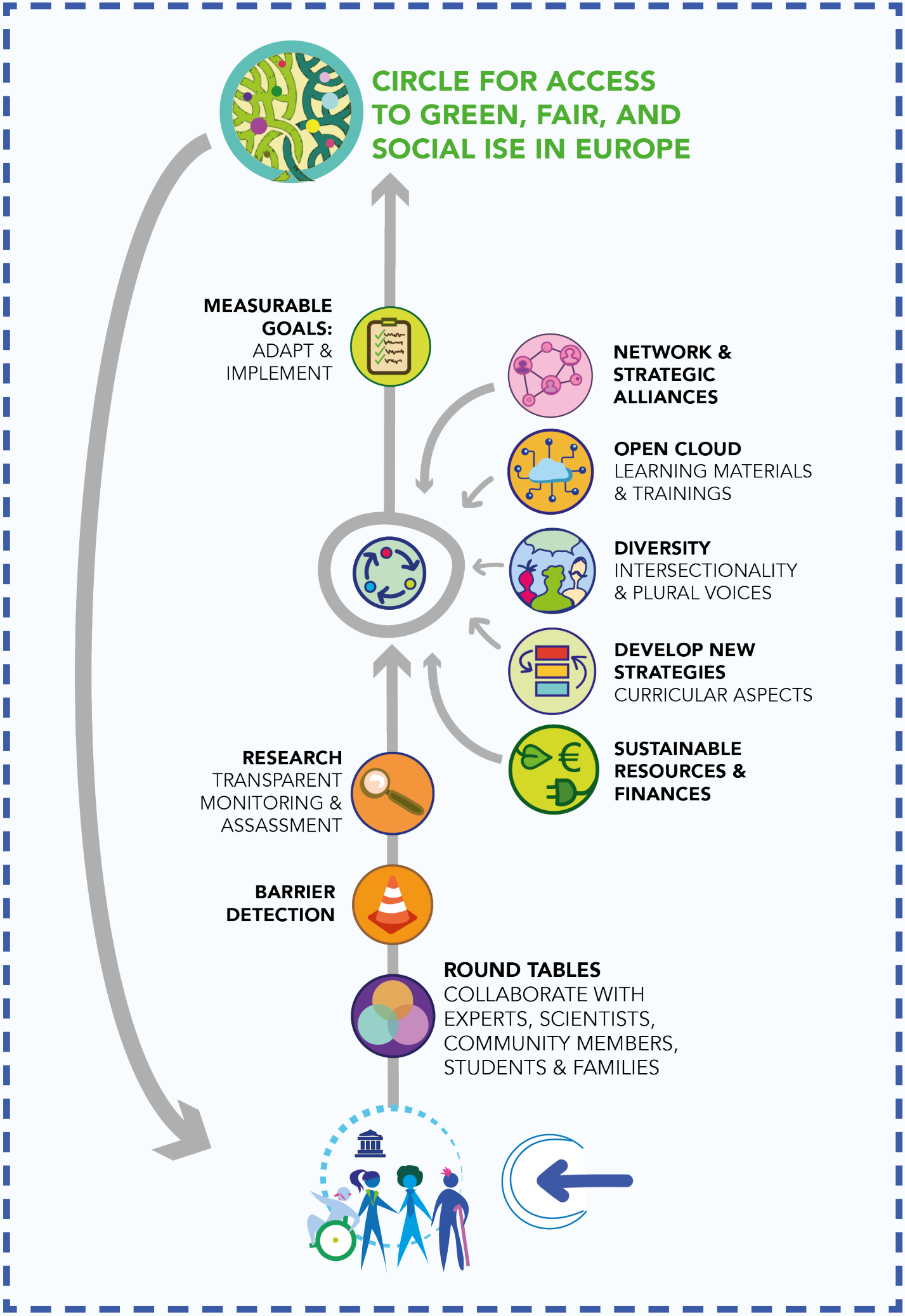
SUSTAINABLE DEVELOPMENT

Numerous goals have been advanced in recent years to address the future and ensure our survival. **We have constructed an economic system that is designed for unlimited growth whithin a limited area.** We live in a world of uncertainties, in which ignorance is the biggest danger when it comes to the implementation of the UN's sustainable development goals (SDGs), even if they are on everyone's lips. **We are far from achieving the climate goals and those for social justice.**

The responsibility of persons in key positions is not only "to do their jobs", but also to be committed advocates and supporters of an inclusive society. This responsibility is reflected in the educational system, as well as in legal and social issues and should be reflected in recruitment procedures, an aspect that especially relevant at the political level, where it must be taken into account.

Effective measures and foundations for implementing all these changes and achieving their goals is not solely up to motivated activists. The linchpin is a legal, transparent framework that is not the province of a privileged few but instead allows and promotes the participation of everyone. Multiple voices need to be loud, and policymakers need to listen, acknowledge, and value them.

ROOM FOR MORE IDEAS:


CIRCLE FOR ACCESS TO GREEN, FAIR, AND SOCIAL ISE IN EUROPE
MEASURABLE GOALS: ADAPT & IMPLEMENT
NETWORK & STRATEGIC ALLIANCES
OPEN CLOUD LEARNING MATERIALS & TRAININGS
DIVERSITY INTERSECTIONALITY & PLURAL VOICES
DEVELOP NEW STRATEGIES CURRICULAR ASPECTS
SUSTAINABLE RESOURCES & FINANCES
RESEARCH TRANSPARENT MONITORING & ASSESSMENT
BARRIER DETECTION
ROUND TABLES COLLABORATE WITH EXPERTS, SCIENTISTS, COMMUNITY MEMBERS, STUDENTS & FAMILIES

ROADMAP FOR POLICYMAKERS

This roadmap for policymakers to advance ISE is designed to be flexible and responsive to the needs and priorities of diverse communities at the grassroots as well as at the structural levels. It should help to ensure that science education is inclusive, equitable, and accessible to all. A comprehensive reform approach to education is needed that considers the multiple factors influencing students' learning and achievement.

BARRIER DETECTION - Addressing systemic barriers to science education, such as power dynamics and marginalization. Identifying blind spots refers to the process of identifying hidden or implicit biases, prejudices, and stereotypes that may exist in the educational system, especially in science curricula and instruction. These biases and stereotypes can present barriers to learning and participation for certain groups of students, especially those from underrepresented or marginalized communities.

DEVELOP NEW STRATEGIES - CURRICULAR ASPECTS: To move ISE initiatives forward requires a thorough review and systematic revision from an ISE perspective of various curricula in science education. This should make it possible to identify and address not only the gaps (in terms of inclusion or exclusion in science education), but also biases and partial narratives (from hidden curricular aspects to zero curriculum practices to colonial and neocolonial narratives). To systematically revise such curricula in advance, it may be useful to form a curriculum revision group composed of experts in gender equity, intercultural education, and disabilities as well as members of at-risk communities.

DIVERSITY, INTERSECTIONALITY & PLURAL VOICES - A POLICY & EDUCATION WORKFORCE: Provide training and support for policymakers designing specific inclusive or pedagogical interventions for teachers and educational institutions. Consider including experts from vulnerable communities as trainers to better understand the needs, potential and daily obstacles these communities may encounter in relation to educational institutions.

OPEN CLOUD: SUSTAINABLE RESOURCES & FINANCES: Ensure that adequate and equitable funding is available for development and implementation of ISE programs. It is essential that funding is accessible to all schools and teachers to provide quality education for all students and communities regardless of socioeconomic status.

MEASURABLE GOALS: Develop specific, measurable, and realistic goals and targets for promoting equity, diversity, and inclusion in science education. This helps ensure children and youth are receiving a high-quality inclusive education that is aligned with national and international benchmarks.

NETWORK AND STRATEGIC ALLIANCES: Promote collaboration and partnerships among schools, universities, museums, and other relevant organizations to share resources, knowledge, and expertise. A viable and sustainable network that provides protection, visibility, active social engagement and community empowerment in vulnerable situations cannot be built alone; success requires connecting a variety of stakeholders who support an invisible (but strong and enduring) network of opportunities, initiatives, and social actors.

RESEARCH & TRANSPARENT MONITORING: Monitoring is essential to detect patterns and gaps in data to promote, boost, or revise ill-fitted policies. For issues related to inclusion, taking into account transparent procedures may be of help to allow detecting issues that otherwise would pass undetected. In this sense transparency may go hand-in-hand with coparticipation and codesign of a variety of stakeholders sensitized to these issues (or affected by them).

ROUNDTABLES: To gain a better understanding of the issues at stake in promoting inclusion through active (antisexist, antiracist, antidisability, etc.) initiatives, it is important to provide an opportunity to look at the situation from a broader perspective and include a plurality of voices at the highest levels. To promote inclusion at the societal level and raise awareness, it is important to create the context in which such awareness is possible and even required. This may mean introducing or allowing new debates to occur on a social level by establishing public forums and panels to identify and address key challenges and barriers to ISE.

ACTIONS AND MECHANISMS
TO IMPLEMENT CHANGE

ROUNDTABLES

The first step in creating new strategies for ISE is to develop a clear and compelling vision of what ISE means and why it is important. This vision should be developed in consultation with relevant stakeholders. Neccesary and useful policies and actions should be adjusted as needed based on monitoring and evaluation of progress to ensure their effectiveness in achieving the goals and objectives for ISE.

Work with a plural workforce that includes the views and interests of communities at risk.

Adjust interventions as needed in feedback loops and assessment.

To promote inclusion at a societal level, and in particular to create awareness in areas such as science, context must be created in which such awareness is possible and even necessary. This may involve new debates at public forums and on panels that are established to give a platform to challenges and barriers to ISE. Public forums/panels could also help to publicly reflect on inclusion and diversity in European policy by having community members and experts from diverse backgrounds provide a broader and deeper understanding of the issues at hand.

The roundtable is the meeting point between policymakers, practitioners, and communities and therefore, the beginning of sustainable change in European educational systems. Creating opportunities for a chorus of voices to be heard at both the policy and grassroots levels to identify biases in science education initiatives may be one way to define the current situation at the local and global levels.

RESEARCH - TRANSPARENT MONITORING AND EVALUATION

Next, policymakers should establish a system for monitoring and evaluating progress toward the goals and targets for ISE. Regular data collection, analysis, and reporting involve:

Ongoing consultation and cooperation with relevant stakeholders and experts.

Allocate resources to develop tools for tracking progress/gaps in ISE initiatives

Proceed with gap analyses to detect any gaps in the metrics and analyses that affect communities in vulnerable situations to obtain relevant data for ISE initiatives.

Start a grassroots data collection with members of these communities, family representatives, students, and other stakeholders. This process should be based on the following:

- SPICED indicators - Subjective, Participatory, Interpreted, Verified, Disaggregated.
- KPI - Key Performance Indicators.
- SMART indicators - Specific, Measurable, Attainable, Realistic, Timely.

Collecting disaggregated data that provides finer-grained information to identify barriers to ISE initiatives or biased approaches that may lead to exclusionary processes (or other negative impacts) when science education initiatives are implemented with specific social groups. The codesign of a code of conduct can also be helpful in ensuring that ISE initiatives use appropriate data collection and analysis procedures to communicate and implement these data in an inclusive manner to achieve appropriate positive impact.

Enforcing a transparent monitoring and evaluation measure in support of these initiatives that ensures EU governance teams responsible for evaluating and tracking educational initiatives in science (funding initiatives, science educational policy regulatory bodies, etc.) have intersectional and diverse representation and conduct regular audits of diverse representation on EU governance teams.

BARRIERS

Identifying the challenges and barriers to ISE, which include resource constraints, limited access, biases, and stereotypes in the curriculum is the first step to inclusion. Based on these findings, a set of specific and measurable goals and objectives must be developed that emphasizes equity, diversity, and inclusion in science education. There is a need to address the systemic barriers such as power dynamics, marginalization, and privilege in science research that limit the full participation of certain student groups. A pluralistic workforce, in which children and families have the opportunity to consider issues from multiple perspectives should also avoid or expose barriers that affect specific communities or social groups. Policies do not always facilitate the implementation of such a diverse workforce (scholars who are experts in and members of communities in risk situations). We recommend taking steps to guide the promotion of a diverse workforce and its inclusion in schools to actively counteract barriers. It is important to raise awareness of inappropriate aspects of the curriculum that still exist and can lead to prejudice and stereotyping or render entire social groups invisible. Intersectional pedagogical teams should be formed and used to track curriculum conceptualizations of diversity and gender in science at the EU and national levels and develop recommendations to ensure that a diversity and gender-aware science curriculum is progressively implemented. It is also important to take steps to provide space and time to think about curricula collaboratively with a diverse and multidisciplinary team, including representatives of community members, and consider the following recommendations:

Use evaluation forms (for educators, for students, for others?) to identify scientific contents that should be revised or can still be used.

Develop strategies to implement the revised science education curricula in the teaching-learning situation.

Consider an adequate timeline for the whole process (recommendation > 1 year).

DEVELOP NEW STRATEGIES - CURRICULAR ASPECTS

To move ISE initiatives forward, a thorough review and systematic revision of content in the various science education curricula from an ISE perspective is first needed. This should allow identification and addressing of not only the gaps (in terms of inclusion or exclusion in science education), but also the presence of biases and partial narratives (from hidden curricular aspects to zero curriculum practices to colonial and neocolonial narratives). To systematically revise such curricula in advance, it may be useful to form a curriculum revision group composed of experts in gender equity, intercultural education, and disability as well as members of at-risk communities.

DIVERSITY, INTERSECTIONALITY & PLURAL VOICES A POLICY & EDUCATIONAL WORKFORCE:

One of the key factors in implementing high-quality standards in European educational systems is the provision of resources to support regular training at the institutional and policy levels and to support specific ISE mechanisms, public initiatives, and pedagogical strategies for teachers to enable them to teach in inclusive and culturally responsive ways. Professional development opportunities, mentorship programs, ongoing support, and guidance are factors that support ISE initiatives in pedagogical contexts, especially when teachers are experts from vulnerable communities, and expertise that facilitates understanding ISE issues from a closer perspective. Specific inclusive or pedagogical interventions for teachers and educational institutions could be designed, for example, with experts from vulnerable communities as trainers. Needs and daily obstacles, but also the potential that lies in diversity, can be best communicated in this way.

This will allow the design of interventions and policies that impact educational realities with a better awareness of the barriers and processes of inclusion in educational settings and may allow the offering of more inclusive and culturally responsive science education initiatives.

OPEN CLOUD: SUSTAINABLE RESOURCES & FINANCES:

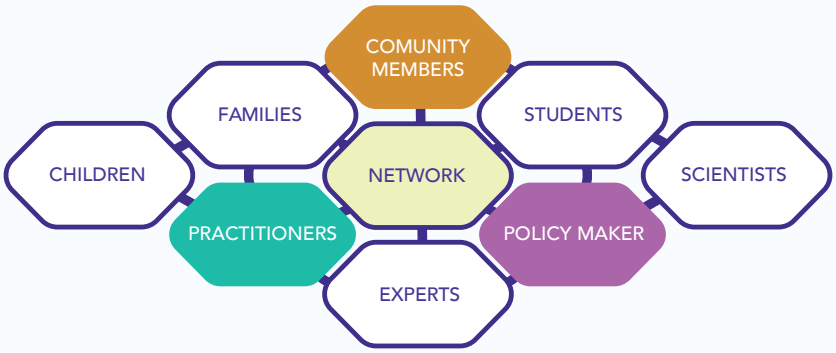
Adequate funding is essential to the development and implementation of ISE programs. Policymakers should consider increasing funding for ISE initiatives and ensure that funding is available to all schools and communities regardless of socioeconomic status. Commit to funding teacher training, technology, textbooks, and other resources necessary for effective teaching and learning. Adequate resources will help ensure that all students have equal access to a high-quality science education. Consideration should also be given to establishing a new EU flagship program for ISE initiatives:

Promoting inclusive activities and spaces and opening opportunities for change toward antisexist, antiracist, and anti-AIDS initiatives (among others) can be facilitated through the creation of new flagship programs that address these issues. **Developing such programs to provide funding and data for new strategies and initiatives should be a priority. Such programs may be possible with the help of new or improved monitoring tools and disaggregated data and through collaboration with stakeholders working on these specific issues.**

There is a very clear example of undiscovered barriers from teachers' accounts of their experiences during the pandemic in terms of teaching materials. Homeschooling was a very difficult endeavor in many schools due to the lack of adequate equipment in many families. There was often only one device available in the household for several people at a time. Many families did not have an Internet connection at home, and participation in classes was only possible via the data volume of the parents' cell phones. A sensible solution would have been, for example, to provide families with free Internet access. Good networking between political and municipal decision-makers and educational institutions leads to targeted and effective solutions, as needs and necessities are experienced first-hand.

NETWORKING AND STRATEGIC ALLIANCES:

Collaboration and partnerships are essential to developing and implementing effective ISE programs. Policymakers should encourage collaboration among schools, universities, museums, nongovernmental organizations, and other relevant organizations to share resources, knowledge, and expertise.



Supporting and building strategic alliances with key decision-makers from at-risk communities who can drive successful and impactful ISE initiatives is essential. In line with promoting Moeda's 3 O's (Open Innovation, Open Science, Open to the World), establish a Science Cloud, as proposed in the Council Conclusions on the New European Research Area, to foster innovative ISE approaches: Facilitate a European ISE approach through the open cloud, modeled on the Open Science, Open Voices, Open Barriers cloud initiative whereby key scientists from diverse backgrounds can use the EU Cloud platform to share their knowledge and experiences of barriers, exclusion, and inclusion initiatives in science and science education.

In the Manresa HUB, to promote ISE among educators, partnerships were forged with Catalan government officials and community representatives through a local working group. Monthly meetings allowed to plan large events, such as national conferences and workshops, as well as use official government communication channels. Speakers from target municipalities and other academic and equality-oriented institutions were selected in collaboration. A collaboration with the Manresa City Council, where proposals were developed with teachers and children in the C4S Community Living Lab on the riverfront, were shared with local officials. This gave the children a sense of civic participation, and the municipality made improvements in the area that benefited families.

MEASURABLE GOALS

Policymakers should identify a set of strategies and actions to achieve the goals for ISE. These strategies and actions should be initiatives that:

Increase Access To Science Education	Promote Cultural Sensitivity In Curricula	Address Systemic Barriers To Science Education

Once strategies and actions are identified, a comprehensive implementation plan should be developed that includes timelines, responsibilities, and resources needed to achieve the goals for ISE. All steps in this process should be developed in consultation and with advice from relevant stakeholders. Most important is flexibility to accommodate changes in priorities and circumstances. All developments and improvements, as well as issues and problems, are related to a structural level, and policymakers CAN bring about change.

Governance should involve an array of bodies with sufficient capability to obtain data and promote policies that may have an impact and sustainability in time. In relation to ISE issues, it is critical to identify a range of institutional strategies, political bodies, and policy actions instrumental to achieve the specified inclusive goals, to reach the target participants in ISE initiatives, and to develop a comprehensive implementation plan in consultation with relevant stakeholders.

Addressing and supporting ISE issues at the policy level includes acting on accessibility and environmental justice to provide children, regardless of their socioeconomic or biographical situations, with equal opportunities to receive quality science equipment as well as access to green spaces where they can learn and discover science phenomena. This aligns with Leaders' 2019-2024 Strategic Agenda and the Council Conclusions on the New European Research Area to promote a green, fair, and social Europe:

Establish mechanisms to track the „less green, less fair" conditions that can hinder access to green spaces for science education activities with children in the EU's disadvantaged neighborhoods.

At the policy level, develop urban planning that considers the link between high-quality science spaces that create awareness of climate justice and sustainability from a STEAM perspective and the promotion of the relevant SDGs.

ROOM FOR MORE IDEAS:

QUOTES FOR CHANGE
LEARN FROM EXPIRIENCE & LET YOURSELF BE INSPIRED

DR. MARTIN SHARMAN

„Most of us would like the future to be more equitable and harmonious than today. How to achieve that? By learning to value and include all of society's members. By benefiting from the collective wisdom and creativity of our diverse populations. Exposure to diverse cultures helps to develop understanding and empathy. If that exposure takes place in a supportive learning environment, it makes it easier to break down stereotypes and correct biases. When individuals from various backgrounds see themselves represented, they can feel they belong and that they have worth. Visibility, acceptance, and inclusion enrich society by bringing together unexpected and interesting perspectives and ideas. They stimulate innovative thinking, encourage clever problem-solving, inspire creativity, and motivate social progress."

Policy officer for DG RTD, European Commission (retired)

MONA SCHERZ:

"Our world is so colourful and diverse, full of wonderfully unique people - each with their own talents, interests and abilities. In order to meet the challenges of our time, such as the climate crisis, we need creative minds and different perspectives, which we can only achieve if we give everyone the opportunity for age-appropriate science education. As an environment councillor, I see it as my duty to create access to these educational opportunities in the natural sciences for children and young people, regardless of which school they attend, how much money their parents earn or where they grow up. If you are also a policy maker, seize this chance together we can move towards inclusive science education for all."

Community councillor for environmental issues

ON INCLUSIVE POLICIES:

"Developing policies that are inclusive and equitable requires the recognition that students' difficulties arise from aspects of the education system itself, including: the ways in which education systems are organized currently, the forms of teaching that are provided, the learning environment, and the ways in which students' progress is supported and evaluated. Even more important is translating this recognition into concrete reforms, seeing individual differences not as problems to be fixed, but as opportunities for democratizing and enriching learning. Differences can act as a catalyst for innovation that can benefit all learners, whatever their personal characteristics and home circumstances."
(UNESCO, 2017, p.13)

>> UNESCO (2017). A guide for ensuring inclusion and equity in education. UNESCO, Paris. ISBN 978-92-3-100222-9 https://unesdoc.unesco.org/ark:/48223/pf0000248254

ON WORKFORCE DIVERSITY IN SCIENCE:

"A more diverse workforce should result in better science and economic benefits. A more diverse representation at leadership level should in turn create longer-term social change. Diverse teams produce better science."
(Royal Society of Chemistry. p.4).

>> Royal Society of Chemistry (2018).Diversity landscape of the chemical sciences - A report by the Royal Society of Chemistry. Royal Society of Chemistry, Cambridge & London. https://www.rsc.org/globalassets/02-about-us/our-strategy/inclusion-diversity/cm-044-17_a4-diversity-landscape-of-the-chemical-sciences-report_web-2.pdf

LITERATURE REVIEW & RECOMMENDATIONS

Find useful documents and publications that provide further information on topics already mentioned or for in-depth research. Many of these documents have provided us with valuable know-how for our work and form a solid basis for this project.

- **C4S Report on Literature (2022). Communities for Sciences. http://www.communities-for-sciences.eu/wp-content/uploads/2022/09/Attachment_0-5.pdf**
- BEIJING DECLARATION - United Nations Report of the Fourth World Conference on Women - Beijing, 4-15 September 1995 https://www.un.org/womenwatch/daw/beijing/pdf/Beijing%20full%20report%20E.pdf
- Boisselle, L.N. (2016). Decolonizing Science and Science Education in a Postcolonial Space (Trinidad, a Developing Caribbean Nation, Illustrates). SAGE Open, 6(1). https://doi.org/10.1177/2158244016635257
- Diversity landscape of the chemical sciences: A report by the Royal Society of Chemistry https://www.rsc.org/globalassets/02-about-us/our-strategy/inclusion-diversity/cm-044-17_a4-diversity-landscape-of-the-chemical-sciences-report_web-2.pdf
- Diversity Workforce in science report from the Royal Academy of Sciences, 2014 https://royalsociety.org/~/media/Royal_Society_Content/policy/projects/leading-way-diversity/picture-uk-scientific-workforce/070314-diversity-report.pdf
- European Commission (2023) Investing in Education 2023, Luxembourg: Publications Office of the European Union, 2023, doi 10.2766/529409
- European Commission, Directorate-General for Education, Youth, Sport and Culture, Investing in education in a post-Covid EU, Publications Office of the European Union, 2022, https://data.europa.eu/doi/10.2766/690624
- European Commission, Directorate-General for Research and Innovation, Science education for responsible citizenship: Report to the European Commission of the expert group on science education, Publications Office, 2015, https://data.europa.eu/doi/10.2777/12626
- European Parliament resolution of 15 April 2015 on the occasion of International Roma Day — anti-Gypsyism in Europe and EU recognition of the memorial day of the Roma genocide during World War II (2015/2615(RSP). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52015IP0095
- European Union 2020. Thematic fiche: Inclusion of young refugees and migrants through education. ET 2020 Working Group on promoting common values and inclusive education
- OECD. (2020). OECD Education Working Paper No. 228: Inclusion of Roma Students in Europe: A literature review and examples of policy initiatives. OECD. https://www.oecd-ilibrary.org/education/inclusion-of-roma-students-in-europe_8ce7d6eb-en
- The Brainwork for Inclusive Sciuence Education: Brauns, Sarah & Abels, Simone. (2020). The Framework for Inclusive Science Education. 1/2020.
- UNESCO (2017). A guide for ensuring inclusion and equity in education. UNESCO, Paris. ISBN 978-92-3-100222-9 , https://unesdoc.unesco.org/ark:/48223/pf0000248254
- UNESCO (2009), Defining an inclusive education agenda: Reflections around the 48th session of the international conference on education, UNESCO, Geneva. http://www.ibe.unesco.org/sites/default/files/resources/defining_inclusive_education_agenda_2009.pdf
- UNESCO (2020). Global Education Monitoring Report 2020: Inclusion and education - all means all. United Nations Education, https://en.unesco.org/gemreport/report/2020/inclusion?fbclid=IwAR1pPaxvEJSZ6iMMVJ-n53KPPHBpUhu9KafF7Y20FoBJR4q1Jlu2Ky4u9wzs
- UNHCR (2017). Main curriculum about refugees, asylum and migration. UNHCR., https://www.unhcr.org/59d354967
- Zinga, D., & Styres, S. (2018). Decolonizing curriculum: Student resistances to anti-oppressive pedagogy. Power and Education, 175774381881056., https://doi.org/10.1177/1757743818810565

PRACTITIONERS

Recommendations Adressed to
Teachers, Trainers, Educators,
Multipliers

IMPORTANCE OF ISE

TRAINING AS THE KEY TO INCLUSION AND MINDFULNESS IN EDUCATIONAL SYSTEMS

ISE in early childhood is important to support and develop children's natural curiosity and to foster their love of learning. It helps to promote diversity and equity in the STEAM fields by providing all children with the opportunity to learn and engage with science, regardless of their backgrounds or abilities.

ISE is the key to closing the achievement gaps between different groups of students, and even in society, by providing all children with the necessary skills and knowledge to succeed in STEAM fields. Increasing critical thinking and problem-solving skills, which are important for success in any field, are just two of many key competences needed for a transformation in educational systems.

Essential to guaranteeing good educations for our children and young people is to target and train a qualified teaching staff. At the multiplier level, there are many interfaces with the other levels that ensure that education can be and remain sustainable and diverse. What is needed is financial support in the school system and in teacher training. Collaborations with stakeholders and communities are essential, but second to the necessity for support, supervision, and fair pay for the existing teaching staff.

INSIGHTS

Education is one of the main foundations of a prosperous society, shaping new generations that will create our future. However, these generations are being raised in an educational system that faces a multitude of challenges at multiple levels, with severe consequences if such challenges are insufficiently unattended. This chapter for practitioners highlights both long-known and emerging, challenges ranging from burnout, to staffing shortages, to teacher training, and their overall impact on the educational system.

AFTERMATH - THE RIPPLE EFFECT

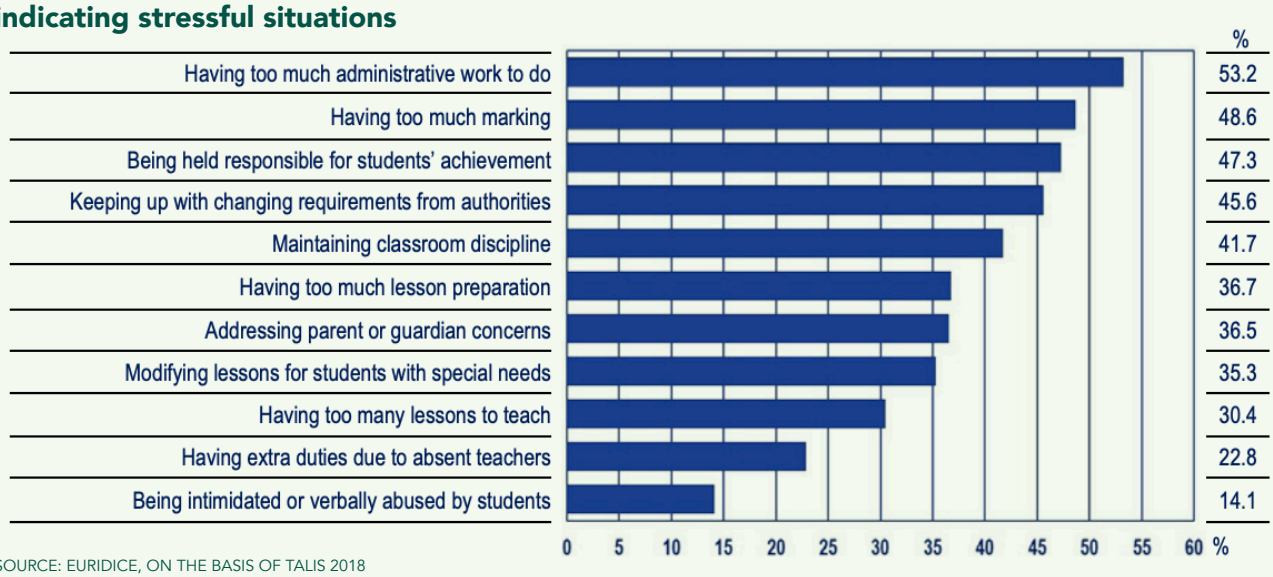
Educational institutions, like social institutions in general, are struggling with a critical shortage of staff, teachers, and support personnel. This drastic situation will worsen in the future. Factors such as low salaries, limited benefits, and increased responsibilities increasingly paint an unappealing picture of the teaching profession. As a result, **schools are struggling to find and retain qualified professionals. The results are larger class sizes, poorer student support services, and diminished learning experiences for students in a system outdated and out of touch with time. Staffing shortages directly impact the quality of education students receive.** With larger class sizes, individual attention becomes more difficult, hindering personalized instruction and affecting student engagement. In addition, the lack of support staff, such as guidance counselors and assistants, limits the ability to address the diverse needs of students, which can lead to gaps in education.

Alternative models and school experiments have existed for many years that work, are integrative and inclusive, and meet learners where they are. Where education for sustainable development is lived, it works. These schools are rare and unfortunately not a standard to follow. Why they fail as standards is uncertain, but nevertheless, numerous studies show models exist that not only provide a positive setting for students but are also positive and enriching for teachers.

The constant stress and strain of regular teaching contributes to high levels of job dissatisfaction and risk of burnout. In some places, the passion, commitment, and motivation that originally animated this profession are extinguished at the undergraduate level: graduates do not even enter the teaching profession, but instead reorient their careers. Given the crushing workload, limited resources, and inadequate support, this is not surprising.

The negative effects of the current state of affairs is not cinfined to the personal well-being of teachers who stay in the system. This is because of the dubious quality of education provided by burned-out educators. Studies on the knowledge levels of children and youth often speak volumes, especially after years of exosure. In addition, not only are there massive gaps in knowledge, but also the overall situation is very stressful for learners and has taken a massive toll on the mental health of the younger generation.

This figure shows the Proportion of teachers at EU level, 2018 in lower secondary education, indicating stressful situations



SOURCE: EURIDICE, ON THE BASIS OF TALIS 2018
https://eurydice.eacea.ec.europa.eu/sites/default/files/teachers_in_europe_2020_chapter_6.pdf

PROMOTION FOR A BRIGHTER FUTURE

Teaching is a wonderful job: Teachers get to support children and young people as they grow up, accompany them as they acquire the knowledge they need to shape their own lives and be there for them when problems arise. Therefore, the training of teachers must be of high quality, preparing prospective teachers for a great but very demanding profession. As noted earlier, a shortage of teachers already exists across Europe. This could be treated as a temporary problem if there were any assurance of sufficient graduates in the pipeline from teacher training colleges to fill these vacancies. But here, too, the influx of would-be teachers and subsequent rates of graduation have been in decline for years. What are the reasons for the dwindling number of student teachers? One of the most important points is certainly the lack of appreciation by political leaders and society at large. Entering a profession in education comes with responsibilities for educational biographies and life trajectories. Challenges to one's mental health require support and self-reflection. Commitment and love for people are both needed qualities that are, quite often put to the test during a teachers life. This profession typically does not confer prestige despite the recognition its practitioners deserve for their roles as advisors, facilitators, initiators, and organizers.

One goal to counteract problems with staff shortages must be to give more recognition to the work and contributions of teachers and to promote the profession again as a wonderful opportunity to work with people.

THE BATTLE AGAINST BURNOUT

Multipliers are high-risk candidates for burnout and mental health problems because of the high demands of their work. Their mental and physical well-being suffers from the multiple burdens of long hours and constant pressure to meet academic expectations, cope with demanding situations in daily school operations, and deal with unexpected aggravations such as the pandemic and its aftermath.

IT'S ALL ABOUT THE TOOLS

ISE is only possible if there are personnel with the capacity to respond to individual situations, people, and their needs. Possibilities are plentyful if there are resources not only financial but also materials that are contemporary, diverse, and inclusive. We are on the verge of a necessary social upheaval in times of climate change, we need mindfulness, courage, and resilience to design an educational system that allows children to envision a livable future and supports educators in accompanying their students on their individual learning journeys.

The overcoming of all these challenges requires comprehensive strategies from different stakeholders at structural as well as individual levels.

DIVERSITY - TOGETHER

In a plural and diverse society, equal opportunities for all are essential to avoid discrimination, exclusion, and segregation. Equity should play a central role also in the areas related to education, not only in terms of transmitting equity values to children but also to implement them on site (e.g., by promoting also a plural workforce, by seeking science representatives from different backgrounds when conducting science educational activities, by listening to the voices of educators from the local communities, by advocating for new pedagogical strategies, and promoting the acceptance of multiple enriching identities, interests, and competences within the school groups, etc.). Thus, to conduct an inclusive science approach is not only a matter of changing the science contents, but also it is essential at an institutional practical level to boost equity and pluralism in the working sites where children will learn and discover the world.


CIRCLE FOR ACCESS TO GREEN, FAIR, AND SOCIAL ISE IN EUROPE
DEVELOP STRATEGIES: EVALUATION & FEEDBACK
MEASURABLE GOALS
SUSTAINABLE RESOURCES & FINANCES
ROUND TABLES DEVELOP STRATEGIES WITH COMMUNITIES & POLICYMAKERS
SUPERVISION SELFREFLECTION
RESEARCH: TRANSPARENT MONITORING & ASSESSMENT
BARRIER DETECTION THE PRINCIPLES OF ISE
FUNDINGS
EDUCATION & PEDAGOGICAL SKILLS TEACHER TRAINIGS, UPDATES & COACHING
PRACTITIONERS
RESEARCH: CULTURAL COMPETENCE
NETWORK: TRANSDISCIPLINARY WORK & EXPERTS
OPEN CLOUD LEARNING MATERIALS, RESOURCES & FINANCES
DIVERSITY, INTERSECTIONALITY & PLURAL VOICES: COLLABORATION & INVOLVEMENT
ROUND TABLES COLLABORATE WITH FAMILIES & OTHER RELEVANT STAKEHOLDERS

ROADMAP FOR PRACTITIONERS

The Roadmap for Practitioners is not only for teachers, it also is is intended for multipliers, educators, trainers, and coaches. It may also serve as a guideline for all these practitioners to develop and grow as mindful experts in inclusive and diverse science education.

BARRIER DETECTION - THE PRINCIPLES OF INCLUSIVE EDUCATION: Teacher training should provide a solid foundation in the principles of inclusive education and an acute awareness of the barriers that can prevent certain groups of students from accessing and engaging with science education.

DEVELOP NEW STRATEGIES: EVALUATION & FEEDBACK: Effective strategies and ISE training programs should equip educators with practical tools and approaches that enable them to create inclusive learning environments and address the needs of individual students. Regular performance evaluation and feedback mechanisms should be put in place to promt continuing professional improvement.

DIVERSITY, INTERSECTIONALITY & PLURAL VOICES: COLLABORATION & INVOLVEMENT: Working together to create science education programs and opportunities for the needs and interests of all students is a process that should involve a diverse workforce. Inclusive education should include diverse stakeholders to ensure that multiple perspectives are considered and that the educational experiences are representative of the community.

EDUCATION & PEDAGOGICAL SKILLS: Teachers need to possess pedagogical skills that enable them to design and deliver science education that is inclusive and engaging for all students, regardless of their backgrounds or abilities. Training programs should offer hands-on practice opportunities and allow participants to work in real-life contexts.

MEASURABLE GOALS: Setting clear, measurable goals is essential for promoting equitable access and achievement in science education. Practitioners should establish benchmarks and indicators to monitor progress and ensure accountability in the implementation of inclusive education and classroom management

OPEN CLOUD: LEARNING MATERIALS, RESOURCES & FINANCES: Access to diverse learning materials and resources is crucial for promoting ISE. Policymakers need to ensure adequate funding to provide equal opportunities for all students, regardless of their socioeconomic backgrounds.

RESEARCH - CULTURAL COMPETENCE, TRANSPARENT MONITORING & ASSESSMENT: Educators should work with diverse groups of students to understand and respect their cultures and be aware of how cultural factors may influence learning. Teacher training programs should incorporate components focusing on cultural competence and adapted to the specific contexts of the participants. This approach ensures that educators are well-prepared to create an inclusive environment and diversity.

ROUNDTABLES: Roundtables under the practitioners' sponsorship are needed to provide collaborative platforms where educators, policymakers, experts, rolemodels, and community members come together to discuss and share experiences and develop strategies to solve complex challenges related to ISE. These discussions are an opportunity and a necessity to share valuable insights, strategies, and best practices to foster collaborative efforts to improve science education access and equity for all learners.

SUPERVISION: RESILIENCE, PERSONAL & PROFESSIONAL DEVELOPMENT: Staying up to date with the latest research and best practices is essential in ISE. It is important to be a lifelong learner and to seek out professional development opportunities. Teachers' training should include opportunities for participants to continue their learning and professional development long after the training is over. Training should also include mentoring and coaching support that can help participants to apply learning to their own contexts and prepare them to overcome challenges they may encounter. Teachers benefit from guidance and support in implementing inclusive education practices. Supervision and mentorship programs provide valuable insights, help navigate challenges, and refine teaching strategies to better serve all students.

EDUCATION & PEDAGOGICAL SKILLS, & ISE TRAINING

Education and training are the first essential steps, for both personal and societal development, to create inclusive environments.

Value diversity, promote understanding and respect

Ensure that every individual has an equal opportunity to learn, succeed, and contribute to society.

Because certain specific competencies and skills are needed to create an inclusive learning environment in STEAM subjects, training to develop such competencies related to diversity and universal design should be provided. This enables educators to successfully implement accessible ISE programs. Participatory practice that facilitates collaboration with families, children, and neighbors in cocreating and participating in STEAM initiatives requires knowledge of communication, human sensitivities, and cultural openness. Understanding and acknowledging existing barriers to accessing science education for certain groups of students and being prepared to overcome them requires the intentional use of strategies to work effectively with diverse groups of students: among these are respect and acceptance of the impact of culture on learning. Pedagogical skills are essential to design and deliver engaging science lessons to students from diverse backgrounds and abilities. Fundamental concepts of pedagogy and educational science, as well as innovations in these areas, provide a solid foundation for comprehensive education.

As part of the C4S, program trainings for teachers were developed. HUB Milan, in collaboration with the Municipality of Sesto San Giovanni conducted a training course on inclusive education that was attended by 191, mostly non-specialized support teachers from 7 comprehensive schools in Sesto San Giovanni. In the Giocheria Laboratori professionals from 4 public kindergartens in Sesto San Giovanni completed a scientific training program in 6 sessions on „Forces and Balance". Through these educational programs, educators can improve their competencies and skills in ISE to promote an inclusive learning environment for all students.

BARRIER DETECTION - THE PRINCIPLES OF INCLUSIVE EDUCATION

The next step is the process of effectively removing barriers and promoting inclusive education. It begins with a needs assessment invilving students, teachers, and stakeholders to identify areas in which inclusion and diversity are lacking. This assessment includes identifying potential barriers related to physical, economic, and cultural factors in and around the school. A situational analysis of data on student achievement, enrollment, and graduation rates will reveal very effectively those disparities that form barriers to achievement for certain groups.

- **Engaging with stakeholders is an essential part of this assessment.** Collaboration is needed with students, families, and community members to understand their experiences and needs. Seek feedback and input from underrepresented groups to ensure their voices are heard and what they say is reflected in changes that flow from the assessment. Establish partnerships with community organizations. Foster a sense of belonging and inclusion among students by valuing their cultural backgrounds and identities.

- **A properly executed assessment in all likelihood will lead to adaptations in instructional practices.** An essential part of is that teachers engage in self-reflection to ensure they are free of personal biases and stereotypes that may affect their instructional practices. Other steps to ensure implementation of effective instructional practices include: Attending pro fessional development opportunities to enhance cultural competency and inclusive teaching strategies; use culturally responsive teaching methods that incorporate diverse perspectives and experiences; provide differentiated instruction to meet the unique learning needs of all students; create a supportive and inclusive classroom environment that celebrates diversity and promotes mutual respect.

- **Promoting equity and access should involve advocating for** the removal of barriers to science education, such as limited resources or financial constraints. Other steps are: Facilitate early exposure to science education for underrepresented students; offer mentorship programs and opportunities for hands-on lear ning to support students' scientific exploration; encourage and support students in pursuing STEAM careers by providing guidance and showcasing diverse role models; collaborate with colleagues to develop and share inclusive teaching practices and resources.

- **Finally, continuous improvement should be the ongoing goal of educational practices.** To that end, regularly evaluate and reflect on instructional practices to ensure their effectiveness and inclusivity. Other steps are: Stay updated on research and best practices in ISE; seek op portunities for professional growth and learning to enhance teaching strategies; and advocate for policy changes and resources that support ISE.

By applying these checkpoint strategies, educators can actively contribute to the implementation of ISE that promotes equity and ensures that all students can succeed in science. However, the basic prerequisite for practitioners to be successful is a legal framework and access to education at the structural level.

RESEARCH & CULTURAL COMPETENCE

Continuous learning and development are essential to staying informed about the latest research and best practices in ISE. For coparticipatory local STEAM research pursue:

Areas of common action-research with families in the pedagogical and neighborhood settings

Mechanisms of field research with families on the local community history and culture and establish connections with STEAM activities

Action-research processes to evaluate the STEAM proposals from a Universal Design and non colour-blindness or gender-blindness approach

For example, HUB Milan collaborated with six state kindergartens to conduct action research on professional development in inclusive science education. The aim of the action research was both to understand how to implement ISE and to improve practitioners' pedagogical practices. Two different pathways were offered, focusing on forces and equilibria and light and shadow. Regular group meetings were held during the courses to facilitate knowledge sharing and reflection among teachers, educators, and project coordinators.

Integrating research and data collection into education, particularly in local STEAM research, to capitalize on its potential to inform inclusive and impactful initiatives in education that align with community needs and aspirations. This could be achieved through collaborative research with families and through special consideration given to neighborhood. This research should focus on understanding the history and culture of the local community and establishing connections between the community's heritage and STEAM activities. By involving families in the research process, a deeper understanding of the local context leads to more meaningful and relevant STEAM initiatives. Additionally, the research process should include the evaluation of STEAM proposals from a Universal Design perspective, taking into account diverse perspectives and needs, without biases involving ethnicity, gender, or culture.

To collect data and assess the impact of participatory STEAM research, a pre-post questionnaire was designed. This questionnaire, developed by C4S, aims to assess the context and awareness of Community Learning Labs (CLLs) and Inclusive Science Education (ISE) prior to the pilot phase and to assess the impact of the pilot. It includes areas specifically related to parent involvement and outside experts. Conducting regular surveys using this questionnaire can serve as a tool to monitor and measure the level of participation in local STEAM research and ensure continuous assessment and improvement.

DIVERSITY; INTERSECTIONALITY & PLURAL VOICES: COLLABORATION & INVOLVEMENT

Promoting diversity in schools and educational institutions is essential to creating an inclusive and enriching learning environment. This requires engaging a variety of voices, including families and people who can tell successful stories related to STEAM activities or initiatives and who are also visionary role models in real-world projects. Through this active involvement of diverse community members and experts, schools can present role models that inspire students. Children and youth will engage with these diverse role models from different backgrounds, experiences, and accomplishments in STEAM areas.

Organizing events or workshops requires funding and qualified staff as well as resources. Support for underrepresented groups and partnerships with community organizations that advocate for diversity in education should become a given. Actively advocating for diversity and encouraging the participation of diverse and pluralistic voices from different backgrounds is a sure way to create an inclusive and supportive environment in and for schools and educational institutions that recognizes and values the contributions of all students, families, and community members.

Engage a variety of voices of expertice and scientists from the communities.	Promote active involvement of different community members and experts	Boost outreach initiatives to ensure participation of community members and families

SUPERVISION: RESILIENCE, PERSONAL & PROFESSIONAL DEVELOPMENT

As a multiplier committed to ISE, it is important to prioritize resilience in the face of challenges. Building a support network of like-minded educators, continuously learning about best practices in ISE, and reflecting on one's own teaching practices should lead to identifying areas for improvement.

Rather than striving for perfection, focus on progress and celebrate successes while maintaining a positive attitude and being open to feedback. Building positive relationships with students, families, and communities will help educators/trainers to understand and meet the needs of students. Prioritizing self-care and maintaining a healthy work-life balance is essential for staying resilient. Being flexible and adaptable in the face of challenges will help educators find creative solutions to obstacles.

Supervision should be collaborative and inclusive, providing educators with support, guidance, and feedback as they work to implement inclusive strategies. By prioritizing resilience and diversity, multipliers create a more inclusive and equitable science educational setting for all students.

Observation is needed, with the supervisor observing the educator's teaching practices in the classroom and providing feedback on areas for improvement. Reflection enables multipliers to critically evaluate their own teaching and identify areas for improvement.

Setting specific, measurable goals helps to create a plan for achieving those goals. Feedback should be given regularly to adapt strategies to changing conditions.

Evaluation of the supervision and feedback process is necessary to improve it and ensure that educators are meeting their goals for ISE.

Unfortunately, social work professions often devolve into a suboptimal work/life balance. The profession of teaching demands a great deal of strength and energy if one takes this task seriously. That's why, especially here, a healthy work/life balance is essential to be resilient. Educators need to take care of themselves to effectively support their students. You can only be flexible and adaptable if you have enough personal resources. Challenges are inevitable, and if educators are open to new approaches, they can find creative solutions and remain resilient with adequate support on a personal, but more importantly, structural level.

Supervision is a collaborative process in which the supervisor and educator work together to achieve the goals of inclusive science teaching. Through observation of instruction, supervisors provide feedback on strategies and techniques to make science instruction more inclusive. They also work with educators to set specific, measurable goals and develop a plan to achieve them. Reflective practice not only promotes students' own critical thinking, it is also very effective in identifying opportunities for improvement in classroom practices. Professional development opportunities such as workshops and seminars should ideally be a permanent fixture in the educational landscape for all teachers, trainers, and coaches. Supervisors, however, not only provide support and guidance to educators in implementing strategies for ISE, but also, and more importantly, help them overcome challenges in their day-to-day school interactions with students and their environments.

The teaching profession is one of the professions most frequently affected by burnout: therefore, resilience is a goal that practitioners needs to achieve. The multiple stresses in pedagogical and social professions have increased significantly in recent years. It is not only important to provide students with a good, future-oriented education, but also to create a safe, stable, and supportive environment for educators.Flexibility is a key skill in meeting the diverse needs and demands of a group. Continuous evaluation and adaptation of methods and strategies are one way to develop and establish quality teaching and classroom management.

OPEN CLOUD: LEARNING MATERIALS, RESOURCES & FINANCES: BIBLIODIVERSITY & MULTILINGUALISM

As a multiplier, incorporating bibliodiversity and multilingualism into ISE means to promote a better understanding and appreciation of the world around us and leads to a more inclusive and equitable society in which everyone is valued and respected for who they are. Making science books accessible for children and families provides a variety of voices and characters, as well as representing different cultures and languages. Doing so helps create a diverse and inclusive learning environment in which everyone can see themselves and their experiences reflected in the books they read. Working with role models from different backgrounds, including those with an intersectional gender perspective, is another route to diversity. Achieving it requires seeking out individuals who can serve as positive examples for children and families, thus breaking down stereotypes and promoting diversity and inclusion.

Try to promote bibliodiversity, multilingualism, and universal design materials	Use science books accessible for children and families with a variety of diverse characters	Work with experts and role models from STEAM fields that represent different communities

In the Bambini Bicocca Pilot of the HUB Milano, the teacher set up the atelier every day with various books, trying to come up with varied bibliographic material that presented subjects from different communities.

The development of adequate learning and teaching materials requires time, competent personnel, and, above all, financial resources. It is often the case that many ambitious projects or project-based teaching fails because of a lack of money. It is not uncommon for motivated teachers to put together teaching materials in their free time or sometimes even pay for them themselves. These are situations that could be alleviated by a change in funding and provision of resources by policymakers.

ROOM FOR MORE IDEAS:

STRATEGIES, EVALUATION & FEEDBACK:

Top-down and bottom-up are approaches to decision-making and problem-solving that differ in their focus and methodology. Both approaches have their strengths and weaknesses, and the most effective approach often depends on the situation and the needs of the organization. In some cases, a combination of both approaches may be necessary to achieve the best outcomes. Practitioners as coresearchers should be aware of these two approaches and informed about their crucial roles. Effective practitioners are adaptable, responsive, and able to navigate between different approaches, to achieve the best outcomes for the communities they serve.

A top-down approach is a hierarchical approach that starts with the highest level of management and works its way down to lower levels of the organization. Decisions are made at the top and then communicated to lower levels, who implements them. This approach is characterized by centralized control and a focus on overall goals and objectives.

A bottom-up approach is a participatory approach that starts with individuals at the lowest levels of the organization and works its way up. Decisions are made through a process of consultation and collaboration, with individuals at lower levels contributing their ideas and suggestions. This approach is characterized by decentralized control and a focus on local **needs and perspectives.**

Here are several checkpoints for practitioners to develop strategies and stay on track when it comes to reflection and evaluation beyond a structural level.

- **Identify the needs** of families in creating safe and welcoming spaces in educational settings through participatory mechanisms, especially involving mothers.
- **Establish a shared space in which** families can contribute materials related to everyday science and STEAM knowledge that are periodically curated.
- **Hold meetings with families** to clearly define the content of an information leaflet for families.
- **Organize a coparticipatory workshop** focused on envisioning the ideal school. Invite key figures from the community to foster decision-making. Create a safe space where families feel comfortable expressing their vision for the ideal school and any concerns or barriers they may perceive regarding participation and accessibility.
- **Gather common topics** suggested by workshop participants and teams to address different areas such as welcoming spaces, playgrounds, communication departments, websites, and mother's empowerment workshops: ensure diverse representation in each team.
- **Conduct field action-research** in collaboration with families and community members to identify needs, propose solutions, develop prototyps and vot for the best among them, implement changes, evaluate the outcomes of change, modify the original proposals, and share the results.
- **Incorporate cultural relevance into instruction**, using examples and scenarios that relate to students' own cultures, and value their linguistic and cultural assets. Shift the focus from treating all students the same to recognizing and addressing the unique needs and experiences of each student.

In this context, it is crucial to recognize and value the role of vulnerable groups in academic positions and their contributions. Gender and identity-based discrimination, as well as social and cultural backgrounds, are still factors to be promoted and addressed in many fields. Equal promotion and appreciation of the achievements of all people working in academia contributes to the creation of a more inclusive and diverse academic environment.

There are indeed members of communities in academic settings, but they often hide their backgrounds in fear of stigmatization, discrimination, and reduced access or job opportunities. This knowledge reveals structural deficiencies and should prompt us to work actively towards inclusion.

MEASURABLE GOALS

In ISE, sustainable development is of utmost importance. To measure progress and further develop a chosen path or a developed strategy requires defined, realistic goals. Similar to a living organism, education thrives on linkages, dynamic relationships, and synergies. **Barriers often arise or only become recognized when institutions and organizations are alert to suspecting their presence. Identifying them, then dismantling or adapting them to create a more inclusive educational environment is critical.**

This is where the IOOI framework can become a useful tool. ***IOOI* stands for Input, Output, Outcome, Impact and is a structured method for examining efficiency**, identifying opportunities for improvement, and ensuring that resources are being used wisely to achieve desired educational outcomes. The following is an explanation of the terms as they relate to educational systems and the resulting developments. It also **shows its use to assess the effectiveness and efficiency of a program or project, to identify areas for improvement, and to ensure that resources are being used effectively to achieve desired outcomes.**

CAUSAL CHAIN

Inputs: The resources and investments, such as funding, manpower, materials, and equipment, required to implement a program or project.

Outputs: The tangible products or services that are produced as a result of the program or project, such as training materials, workshops, or services provided.

Outcomes: The expected results or impacts that the program or project is intended to achieve, such as increased knowledge, skills, attitudes, or behaviors.

Impact: The long-term and broader effects of the program or project on individuals, organizations, and society, such as increased economic development, improved health, or reduced poverty.

LEADS TO

INCREASING:

- **The number of underrepresented students in science education programs** such as students from low-income families, students of color, and students with disabilities.
- **Underrepresented students who pursue careers** in science, technology, engineering, and mathematics **(STEAM) fields.**
- **The number of educators** who have received training in **ISE.**
- **Students who join science-related extracurricular activities** such as science clubs or science fairs.
- **The number of students who join science-related field trips** or other hands-on learning experiences. Students who report feeling engaged and excited about science.
- **Number of students who are able to transfer their science learning to real-life scenarios.**

DECREASING:

- **The achievement gap between different groups of students in science education.**

IMPROVING:

- **Cultural relevance and representation of science education**, such as including more diverse perspectives and role models.
- **Sience achievement scores of underrepresented students**, as measured by standardized tests or other assessments.

QUOTES FOR CHANGE
LEARN FROM EXPERIENCE & LET YOURSELF BE INSPIRED

DR. MARTIN SCHEUCH

„The earlier it is natural to deal directly with the phenomena of the world, the better. The goal here should be to get direct access, not just explanations and didacticized second-hand experiences. The explanations are important, but the starting point should be the children's interest, the phenomenon itself with its impulses for learning.

I think fundamentally,(::) that democratic participation is needed EVERYWHERE and human rights should guide all action as a foundation. A crisis of trust (in politics and also "science") can only be addressed, in my view, if both politics and science are recognized as relevant by ALL."

Science Educator, Economist

ANDREA NEUHAUSER

„Through joint research and observation, children develop physical and health awareness as well as language skills and social learning. Through active experience and conscious perception, concepts such as health and environmental awareness become tangible.

In this way, a "new" normality is to be created, so that inclusion as a concept would no longer have to be mentioned separately, but is anchored in every person as a principle. Likewise, that nature and man are seen as one system in order to be able to react to environmental problems in the future with new ways of solving them."

Primary Teacher for Disabled Children

CAROLINA TRCKA-ROJAS, MSc.

"Access to science education is not only beneficial to mental development, it is a human right, no matter the age, ethnicity, gender, ability, cultural or economic back ground. It encourages critical thinking and incentivizes people to examine a problem from different points of view. Science education is vital to understanding the world around us, with knowledge giving people more confidence and increasing indepen dence. There is no downside to scientific literacy, only the lack thereof."

Science Educator, Biologist

ZINO BOISDENGHIEN

"For me, STEM/STEAM is not about more factual knowledge but about attitude. Encouraging an inquisitive and critical attitude in young children helps to form empowered and literate citizens. I also oppose too narrow an interpretation of STEM/ STEAM: for me, the sciences component is about all forms of human knowledge, not just what is classically understood as sciences."

STEM Expert

LITERATURE REVIEW & RECOMMENDATIONS

Find useful documents and publications that provide further information on topics already mentioned or for in-depth research. Many of these documents have provided us with valuable know-how for our work and form a solid basis for this project.

- **C4S Report on Literature (2022). Communities for Sciences. http://www.communities-for-sciences.eu/wp-content/uploads/2022/09/Attachment_0-5.pdf**
- Abels S. (2015). Implementing Inquiry-Based Science Education to Foster Emotional Engagement of Special-Needs Students. In Kahveci M., Orgill M. (eds) Affective Dimensions in Chemistry Education. Springer, Berlin, Heidelberg, pp. 107-131.
- Anaby, D. R., Campbell, W. N., Missiuna, C., Shaw, S. R., Bennett, S., Khan, S., . . . Camden, C. (2019). Recommended practices to organize and deliver school-based services for children with disabilities: A scoping review. Child Care Health Dev, 45(1), 15-27. [https://doi:10.1111/cch.12621] https://doi:10.1111/cch.12621
- Born Selly, P. (2017). Teaching STEM Outdoors: Activities for Young Children. Redleaf Press. https://www.redleafpress.org/Teaching-STEM-Outdoors-Activities-for-Young-Children-P1640.aspx . This book from Redleaf editorial provides orientations and practical guidelines on how to promote science education outdoors in contact with the natural world. Very useful guide for practitioners
- Carol-Ann Burke, L. E. (2020). Informal science educators and children in a low-income community describe how children relate to out-of-school science education. International Journal of Science Education, 42(10), 1673-1696. https://doi.org/10.1080/09500693.2020.1774936
- Davies, D., Howe, A., Collier, C., Digby, R., Earle, S., & McMahon, K. (2014). Teaching Science and Technology in the Early Years (3-7) (3rd ed.). Routledge. https://www.routledge.com/Teaching-Science-and-Technology-in-the-Early-Years-3-7/Davies-Howe-Collier-Digby-Earle-McMahon/p/book/9780415825597
- DES & NCCA (2005). Intercultural Education in the Primary School: Guidelines for Schools. National Council for Curriculum and Assessment (NCCA). https://ncca.ie/en/resources/intercultural_ed_pri
- Diversity Workforce in science report from the Royal Academy of Sciences, 2014 https://royalsociety.org/~/media/Royal_Society_Content/policy/projects/leading-way-diversity/picture-uk-scientific-workforce/070314-diversity-report.pdf
- Husband, T. (2019). Using Multicultural Picture Books to Promote Racial Justice in Urban Early Childhood Literacy Classrooms. Urban Education, 54(8), 1058-1084. https://doi.org/10.1177/0042085918805145
- Khalfaoui, A., García-Carrión, R., & Villardón-Gallego, L. (2020). Bridging the gap: engaging Roma and migrant families in early childhood education through trust-based relationships, European Early Childhood Education Research Journal, 28(5), 701-711, https://doi.org/10.1080/1350293X.2020.1817241
- Khalfaoui, A., García-Carrión, R., & Villardón-Gallego, L. (2021). A Systematic Review of the Literature on Aspects Affecting Positive Classroom Climate in Multicultural Early Childhood Education. Early Childhood Education Journal, 49(1), 71-81. https://doi.org/10.1007/s10643-020-01054-4
- OECD (2010), Educating teachers for diversity: meeting the challenge, OECD Publishing Paris. https://www.oecd-ilibrary.org/education/educating-teachers-for-diversity_9789264079731-en
- OECD DIRECTORATE FOR EDUCATION AND SKILLS - OECD Education Working Paper No. 228: Inclusion of Roma Students in Europe: A literature review and examples of policy initiatives https://www.oecd.org/education/inclusion-of-roma-students-in-europe-8ce7d6eb-en.htm
- Underscores bibliodiversity and multilingualism, Council conclusions on the European Research Area Roadmap 2015-2020 https://data.consilium.europa.eu/doc/document/ST-9351-2015-INIT/en/pdf
- UNESCO (2017). A guide for ensuring inclusion and equity in education. UNESCO, Paris. ISBN 978-92-3-100222-9 https://unesdoc.unesco.org/ark:/48223/pf0000248254
- UNESCO (2020). Global Education Monitoring Report 2020: Inclusion and education - all means all. United Nations Education, https://en.unesco.org/gemreport/report/2020/inclusion?fbclid=IwAR1pPaxvEJSZ6iMMVJn53KPPHBpUhu9KafF7Y-20FoBJR4q1Jlu2Ky4u9wzs
- Winter, J. (2018). Wangari's Trees of Peace (2nd ed.). HMH Books for Young Readers. https://www.goodreads.com/work/best_book/4056408-wangari-s-trees-of-peace-a-true-storyfrom-africa

COMMUNITIES AND INSTITUTIONS

Recommendations Adressed to Community Members, Stakeholders, Museums, Institutions

COMMUNITIES IN EVERYDAY LIFE – LISTEN TO TARGET GROUPS` VOICES

To improve access to ISE, we need to focus on the needs and perspectives of targeted groups and stakeholders. This means taking a holistic approach that includes understanding the unique challenges and opportunities of diverse communities and tailoring educational interventions to meet their specific needs.

When working with children or youth from underrepresented groups, the most important foundation is to create a safe and welcoming learning environment in which their values, cultural identities, and experiences are recognized and valued. Incorporating culturally relevant content into the curriculum and using methods to accommodate diverse learning styles and abilities are essential. This is an ongoing process involving policymakers, stakeholders, and institutions. Therefore, it is crucial to foster collaboration between educators and policymakers. Building strong partnerships and coalitions that can amplify stakeholder voices to advocate for more inclusive and equitable policies is important. Engaging with diverse perspectives and communities through ongoing dialogue and collaboration with targeted groups builds trust and mutual understanding.

The main goal is to establish robust, sustainable, and inclusive educational systems that benefit all members of society. This necessitates challenging existing power structures and biases that may restrict access and opportunities for certain groups.

INSIGHTS

Community members are a valuable resource for policymakers seeking to develop inclusive and effective policies. Direct exchanges provide insights into daily realities, and lead to involvement in decision-making processes. Such exchanges also recognize community expertise as such, reflect others' life experiences, and support equity and justice. Communities do not need to be given a voice, the voice is there! Society just needs to learn to listen and acknowledge.

VISIONS BECOME VISIBLE

At the community level, the decisions, strategies, and initiatives implemented by professionals, experts, relevant stakeholders, and policymakers become visible. Those actions have a direct and tangible impact on the community and its members.

Through changes in educational programs, such as inclusive teaching methods or organizing workshops for the community, actions become visible through increased student engagement, participation, and positive feedback from community members. **This does not always necessarily have to be preceded by the transformation of an entire system, because it is highlighted in the chapter for policymakers. As for practitioners, it is often simply individual steps and tweaks that make big differences.**

It is necessary for policymakers whether at the local, regional, or national level to implement policies, allocate resources, and establishe support systems en route to creating a solid inclusive foundation. By prioritizing funding for community-based science educational programs, taking action to promote inclusion, or working directly with community organizations, actions automatically lead to improved educational opportunities for marginalized groups, improved educational outcomes, reduced disparities, increased community engagement, and a more cohesive and inclusive community atmosphere.

Deliberate actions and efforts to promote inclusion, equity, and engagement, create a more inclusive and vibrant community where people from diverse backgrounds have equal access to opportunities and participate actively in shaping the community's future.

DETECTING BARRIERS

To understand how inclusion can and should work, the main factor for success is to be open and non-judgmental. **All of us writing this are in a bubble of privilege. Nevertheless, every one of us probably has witnessed discrimination or acts of injustice and unfairness that we failed to recognize because of our lack of awareness. Gaining such an awareness of structural or social barriers to full societal participation by minorities or underrepresented groups requires self-reflection and frank (and perhaps painful) dialogue with members of such groups. Once identified, addressing these barriers requires a comprehensive approach** that includes awareness campaigns, enactment of legal protections, policy reforms, community engagement at all levels, and the promotion of inclusive and equitable practices in all sectors of society. Discrimination in any form, blatant or sublte, hinders access to educational, employment, and economic opportunities for individuals and entire groups.

Social exclusion and marginalization impede or even prevent full participation in social, cultural, and political activities. Feelings of isolation, lower social support, and limited social networks have significant psychological and emotional effects on people. Among them are increases stress, anxiety, depression, and lowered self-esteem. A lack of (personal) confidence in a hostile social environment affects more than just mental health. Unequal treatment in various areas such as health care, housing, or public services manifests itself directly through physical signs and symptoms.

Xenophobia, ignorance, and lack of acceptance lead in the worst cases to acts of violence, hate crimes, or harassment against individuals or groups within a community. This can undermine social cohesion and create divisions within communities.

Discrimination perpetuates systemic inequities and reinforces existing power imbalances and hierarchies in society. Challenge often intersects with other forms of marginalization based on race, gender, class, sexuality, and other social identities. It takes action at all levels of our society for education for sustainable development. Of course, change at the structural level is paramount. But each person can start for themselves, every day and in each single situation.

LANGUAGE AS A POWER TOOL

Language is a powerful tool to express ideas, beliefs, and values. The words we use can shape our thoughts, attitudes, and behaviors. The way we talk about something can affect how we perceive it, how we interact with it, and how we make decisions. The phrase "words create reality" sums up the idea that the language we use shapes our understanding of the world and influences our perceptions and experiences. It suggests that the words we choose to describe and communicate something not only reflect our existing reality, but also have the power to shape and construct our reality.

For example, the language we use to describe social problems can influence how we perceive and respond to them. Using dehumanizing language or stereotypes can perpetuate prejudice and discrimination, but using inclusive and respectful language can foster empathy, understanding and social cohesion.

Throughout the C4S project activities we ourselves were challenged to question the way we use certain terms and language in general. For example, the term "vulnerable groups" is often used to describe communities or populations that are at higher risk or disadvantaged, but the phrase can be problematic. For example, there is certainly a tendency to lump people with different identities, experiences, and needs under a single term that ignores their unique characteristics and circumstances. The use of the term "vulnerable groups" can lead to homogenization and simplification in discussing and describing different complex communities. In our work and in the experience, we have gained, it has become clear that a term like "vulnerable groups" reinforces negative stereotypes and perpetuates a narrative of victimhood or helplessness.

Language can also often unintentionally marginalize and stigmatize individuals or communities, associating them exclusively with their vulnerabilities rather than acknowledging their strengths, resilience, and agency. Labeling certain groups as "vulnerable" implies a power imbalance, reinforces an "us versus them" mentality, and can perpetuate paternalistic or deficit-oriented approaches that further disempower the very communities that we seek to help.

It is a fact that people have multiple identities at the same time that intersect and shape their weaknesses and strengths. Using a single term hides these nuances. Thus, instead of using the term "vulnerable groups", a simple solution approach would be, to take a more nuanced and inclusive approach, namely using person-centered language that respects individuals' agency, dignity, and diversity.

Promoting inclusive and equitable approaches that move beyond narrow categorizations of vulnerability is critical. Discrimination has a profound impact on its victims' daily life, creating problems and challenges on multiple levels. Eliminating it requires recognizing and addressing specific challenges and subtle, invisible barriers with people of different identities, circumstances, and experiences. Empowerment, resilience, and strengths-based perspectives should be promoted rather than maintaining focus solely on vulnerabilities.

ROOM FOR MORE IDEAS:

EQUAL OPPORTUNITIES FOR ALL IN A DIVERSE SOCIETY

DEVELOP STRATEGIES
EVALUATE & ADAPT

ROUND TABLES
EVALUATE & ADAPT

MEASURABLE GOALS

RESEARCH THROUGH COLLABORATION

CHANGES ON A STRUCTURAL LEVEL
CAN LEAD TO
BOTTOM UP SELFORGANIZATION & REPRESENTATION

OPEN CLOUD
INCLUSIVE MATERIALS & UNIVERSAL DESIGN

DIVERSITY & PLURAL VOICES
EXPERTS FROM COMMUNITIES & ROLEMODELS

ACCESS TO EDUCATION
RAISE AWARENESS, PARENTS RECOGNIZE THE VALUE OF ISE & ARE WILLING TO ACT

SUSTAINABLE RESOURCES & FINANCES

BARRIER DETECTION & STIGMA

DEVELOP STRATEGIES
COMMUNITY ENGAGEMENT

ROUND TABLES
COLLABORATE WITH COMMUNITY MEMBERS, INSTITUTIONS & FAMILIES

SUPPORT & OUTREACH
THROUGH INSTITUTIONS, SOCIAL WORKERS, JOURNALISM & SOCIAL MEDIA

COMMUNITIES

ROADMAP FOR COMMUNITIES

This map shows a complex path to creating awareness of and access to ISE for targeted audiences and members of diverse communities. The work of C4S has raised awareness of the importance of thinking outside the box. Many ideas have been put to the test in the field. Not everything believed to be helpful proved useful, and often one is trapped in one's own bubble. We explain the most important elements of the roadmap in detail.

BARRIER DETECTION & STIGMA: Access to science education for underserved and marginalized communities means working to reduce financial and other barriers to science education and promoting on a structural level greater accessibility of science educational programs for all students, including those with disabilities who constitute a group often ignored in discussion of neglected communities. For example, ISE necessitates the identification and elimination of stigma for all groups. Policymakers must prioritize dismantling societal misconceptions and biases.

DEVELOP STRATEGIES & COMMUNITY ENGAGEMENT: Strategies are needed in this category to encourage communities, parents, and families to participate in science educational programs, to promote science education as a means of addressing social issues and challenges, and to create opportunities for students to connect science education to their own communities.

DIVERSITY, INTERSECTIONALITY & PLURAL VOICES - EXPERTS & ROLEMODELS: Stakeholders and vulnerable groups should provide support and resources to promote ISE. Creating networks and communities of practice to share knowledge and resources and offering professional development opportunities for teachers and multipliers increases diversity on other levels as well.

EDUCATION - RAISE AWARENESS: Advocate for ISE by raising awareness of the importance of diversity and inclusion in science education. Promoting the benefits of ISE for students, communities, and society is needed and has impact on many levels: in hiring practices, advocating for greater representation of diverse communities in science research and development, and creating opportunities for underrepresented groups to pursue careers in science fields.

OPEN CLOUD: MATERIALS, SUSTAINABLE RESOURCES & FUNDING: Suitable tools, toys, and learning materials for ISE requires financial resources as well as educated trainers and designers to develop and use them. Adapting materials to meet the specific needs of different users and safety considerations are crucial, especially in preventing harm and eliminating hazards, especially with younger learners or persons with disabilities.

MEASURABLE GOALS: DATA & IMPACT: In this category, help is needed in collecting and analyzing data on student outcomes and experiences in science education programs, evaluating the effectiveness of ISE practices, and promote greater inclusivity and equity in science education. Also, there is a need to revise gaps in the metrics and in the promotion of more transparency in the use of data.

RESEARCH THROUGH COLLABORATION: Opportunities in this category include, engaging with providers of science education, such as schools, museums, and science centers, to promote ISE, and to develop inclusive curricula and learning materials based on feedback on the accessibility and inclusivity of science educational programs.

ROUNDTABLES: Roundtables bring together policymakers, practitioners, scientists, and communities as the starting point for a collaborative and inclusive approach to decision-making and problem-solving in education. It is necessary to gather all key stakeholders, include their expertise, perspectives, and experiences in order to work toward common goals.

SUPERVISION, SUPPORT & OUTREACH: Recognizing the everyday challenges faced by individuals in socially vulnerable circumstances is needed. Lack of coping strategies can lead to severe mental health issues especially after situations involving mobs, hate crimes ,and violence. Providing supervision, support, and empowerment opportunities is important to develop resilience within communities, but also for social workers and ensure that individuals can navigate these challenges effectively.

ACTIONS AND MECHANISMS TO IMPLEMENT CHANGE

EDUCATION - RAISE AWARENESS:

At the community level the most important thing is to raise awareness. In the context of ISE in targeted communities, education refers not only to the process of providing equitable and accessible learning experiences in science to individuals within those communities. It goes beyond a process of mere access to a much more encompassing view on science education as **a holistic approach that goes beyond the mere transmission of knowledge and skills.** Inclusive science focuses on creating an environment in which all people, regardless of their backgrounds or circumstances, can meaningfully participate in science learning and actively identify and break through barriers to solutions.

Raising awareness means first to take a (self-) critical perspective in order to be able to deal with the big picture and to understand it. Education should be rethought and looked at from a critical perspective that rejects the colonial perspective that has prevailed for too long. **Plural voices need to be heard in freely chosen spaces in which people have the choice to accept educational offers.** The foremost requirement for this is the creation of safe spaces for families and their common bonds. Numerous roundtables are the key for brainstorming sessions to produce concepts and strategies to fulfill this requirement.

Specific needs and challenges are most often associated with limited resources, socioeconomic disadvantages, language barriers, cultural differences, and systemic inequities. Many people in diverse communities are already hindered or denied equal access to quality science education on a structural level.

Education means a lot more than visiting schools. Education is sensitive, understandable language for all when it comes to journalism, museums, books, signs in public...

Culturally- and gender-sensitive, needs-based instructional practice recognizes and respects backgrounds, experiences and perspectives. It incorporates them into the academic learning process.

Education in this context also means listening and learning for us, as a society. Society should first learn to listen and be open. We are not aware of many of the issues and difficulties that people face every day. And if we are not aware of the struggles of individuals or communities, if we do not communicate but ignore, the educational gap widens.

DIVERSITY, INTERSECTIONALITY & PLURAL VOICES

Diversity must be viewed through an intersectional lens. The heterogeneity of a society is still sometimes pinned down to exclusively visible or obvious differences. However, we are all invited to acknowledge the multilayered and interconnected nature of individuals' experiences. Moreover, it is necessary to be aware of this complexity to change social constructs as well as individuals' prejudices. **A intesectional framework allows for an approach to how privilege and oppression intersect and interact, but more importantly, it opens the possibility of targeting resources and barriers.**

When talking about diversity in the context of intersectionality, it becomes clear that **people are not shaped by just one aspect of their identity but by the intertwining of different dimensions of identity** such as gender, sexuality, culture, abilities, and others factors. This consideration enables the design of inclusive spaces and strategies that take into account the experiences and needs of people with different identities. It is about actively listening to and valuing the voices and perspectives of those at the intersections of different social categories and then working to dismantle the systems of power and privilege that perpetuate inequality and discrimination.

The key to acknowledging and emphazising diversity starts with something as simple as communication. Language creates realities, but it is one of the easiest ways to implement diversity that leads to support and empowerment.

RESEARCH & COLLABORATION:

It is very important to keep targeted groups in mind when collecting testimonials: Not all social groups are necessarily aware of the methods and purposes of the research, which must be clearly presented and explained so that everyone can decide whether to participate.

The empirical research must be calibrated based on the targeted group, considering for example the age of the children and their socioeconomic backgrounds, the location of the educational center, and the specific educational proposals for implementation. Such research could include both the measurement of the actual outputs for example the improvement of manual skills, the acquisition of knowledge of physical processes, and the outcomes: families' greater confidence in educational institutions, improved family-teacher dialogue, and the fostering of curiosity about education in general and science in particular.

Local mappings identify specific needs and guide resource allocation effectively.	Build strategic alliances to foster collaboration and strengthens collective efforts	Boost cultural mediation and outreach to enhance understanding and engagement

ROUNDTABLES

At the local level, it is important to have places for discussion and monitoring. Spaces where all the actors be they political decision-makers, institutions, companies or civil associations involved in strategic planning, implementation, and measurement of the actions sit.

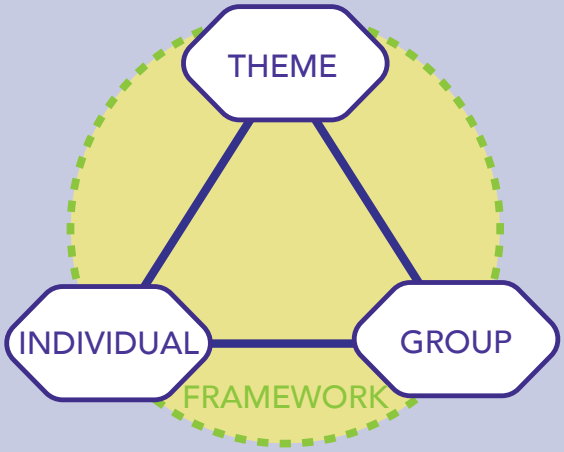
The roundtable methodology may prove useful for this purpose as a way to share expert advice and airing opposing viewpoints on various topics. It can be a tool to involve a limited number of participants, allowing them to actively discuss or act as a collector of needs, opinions, and ideas. Or it can involve many people. When it involves many actors, the roundtable has more value in disseminating strategies and proposals. It is also possible to organize virtual roundtable discussions. It is important to tailor the experience to the background of the audience and involve experts who offer different points of view or areas of expertise.

A simple and inclusive approach to restructuring, not only on an interpersonal level, but most especially on a holistic educational policy, would be that of "Theme Centered Interaction".

Theme Centered Interaction is a valuable tool for community leaders, organizers, and members because of its basic principles of balanced group dynamics and effective communication. The focus is on shared responsibility, which is therefore well-suited to building and maintaining strong communities because the balanced participation of individuals, the task, and the group as such are understood to interact with each other. By sharing responsibilities, a sense of ownership and commitment is cultivated, creating a cohesive and cooperative environment. This is true at all levels.

THEME CENTERED INTERACTION

The Round Table is the interface, a meeting place, the beginning of a transformative process - for both individual and group to effectively implement the basics of TCI. It needs to be reconciled, fostering an inclusive community not only within communities but also of different levels. By growing in the context of the group, an expansion of input and contributions ultimately benefits an entire society.



TCI offers strategies for managing conflict constructively. Collaborative discussions serve to gather interests, concerns, or goals and engage them in issue-centered interactions.

DEVELOP STRATEGIES & COMMUNITY ENGAGEMENT

In the pursuit of diverse and inclusive education for sustainable development, collaboration, and mutual support are key. Overcoming the barriers faced by communities and vulnerable groups requires a multifaceted approach. Here are some useful strategies /enablers:

Introduction to science education for students and even their families at an early age fosters curiosity and interest that can persist throughout the educational journey.

Building partnerships with schools, community centers, and youth programs expands access to science education for underrepresented students.

Financial support such as offering funding, scholarships, or grants ensures that science education is accessible to a broader range of people.

Adopting culturally appropriate teaching methods that respect and reflect students' cultures and backgrounds is essential to rethinking educational systems.

Creating a safe and supportive learning environment in which all students feel respected and valued promotes engagement and success. Collaboration with practitioners is essential.

Giving underrepresented students the opportunity to pursue science education and be mentored by scientists and educators sparks their interest and opens doors to future careers.

Highlighting and promoting ISE as a viable and rewarding pathway encourages students and their families to consider diverse careers in STEAM fields.

The formation of plural teams and the use of cultural mediators assure that all voices are heard. This is a way to increase visibility and ensure accessibility.

Through collaborations and partnerships with higher educational institutions, research centers and industry, students gain insight into real-world scientific research and learn about science from a holistic perspective.

Depending on the local context, different strategies may lead to the successful implementation of ISE. Dialogue and cocreation of environments with members of the community, partners, and practitioners can help to find and adapt pathways.

In order to involve families with different migrant background in the pedagogical initiatives of the Brussels Hub and also to ensure that the communication channels with them were fluent and useful, we got the support of the "Huizeke"* who facilitates the communication between teachers and migrant families of a Brussels primary school. In order to involve the families of migrant muslim background in the pedagogical initiatives a cultural mediator was introduced for the focus group sessions.

This cultural mediator, who also has a migrant muslim background and is a university lecturer and researcher, gave support in the interaction and communication with the families and was also part in the activities involving them. As a result together with the "Huizeke" a very warm and positive atmosphere with the families was created and consolidated and the activities involving them in this Hub were very successful.

** The Huizeke is a Brussels-based organisation that aims to combat poverty by promoting the self-reliance of people living in poverty and working with them to increase opportunities in society. Their mission is to facilitate communication between families and teachers. We work together with two staff members of the Huizeke; Marissa; from Peru and Anahit from Armenia.*

OPEN CLOUD: MATERIAL, SUSTAINABLE RESOURCES & FUNDING

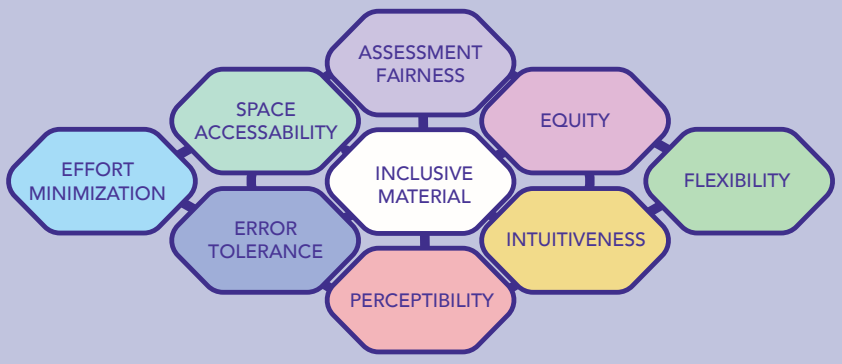
Tools and toys must first be suitable for the targeted group of users, bearing in mind theirage and any manual, visual or hearing difficulties. **The safety of the tools must be absolute**, even considering possible improper handling (e.g., no small parts should be used with preschool children).

This is a clear and comprehensive checklist for selecting and offering materials for educational purposes that consider environmental impact, affordability, accessibility, and educational benefits:

- **Offer Environmentally Friendly Materials**: Provide materials and objects with minimal environmental impact. This is a sustainable practice and teaches uses to care about the environment.
- **Avoid Nonrecyclable Materials**: Refrain from using plastic or nonrecyclable materials to reduce waste and promote responsible consumption.
- **Prioritize Inexpensive Objects**: Choose affordable objects to ensure equitable access to educational resources. Expensive ones might create a barrier for families with economic constraints.
- **Propose Natural Objects**: Suggest objects from nature to foster exploration and appreciation for nature. These materials are often readily available, free, and accessible to all.
- **Encourage Everyday Object Use**: Recommend everyday objects, such pots, funnels, or ladles, to facilitate repeated activities at home to promotes continuous learning and spontaneous creations.
- **Promote Creative and Inventive Games**: Offer games and activities that stimulate creativity and inventiveness, emphasizing that there is no single correct solution. This encourages critical thinking and problem-solving.

A very useful idea to develop learning materials is the concept of Universal Design. Its goal is to ensure inclusivity and maximize participation for all learners by minimizing barriers. Universal Design benefits the entire learning community by fostering inclusivity and providing a welcoming educational environment in which all students can actively participate, learn, and succeed.

UNIVERSAL DESIGN - INSTRUMENTS OF CHOICE



Universal Design creates materials, programs, and settings for inclusive learning to provide access to information and opportunities regardless of ability. This approach provides flexibility **to accommodate different learning styles and simplifies complex content for greater accessibility. It incorporates a variety of formats - text, audio, visual, and tactile - to meet different sensory needs and necessities.** Clear instructions and well-structured materials facilitate navigation and comprehension. **Mistakes, or better errors, are opportunities for growth.** Universal Design develops materials and assessments that support learning from mistakes and promote resilience and adaptability. Physical demands are minimized in favor of students with mobility impairments, and the design of spaces and interfaces are carefully considered to ensure comfortable and safe interactions among all learners. **Promoting collaborative learning and interaction among students of diverse backgrounds and abilities requires Fair Assessment Practices and Alternative Assessment Formats.** These principles form the foundation of Universal Design and contribute to an educational environment designed to meet the needs of all students.

BARRIER DETECTION - BREAKING WITH STEREOTYPES

Stereotypes in science refer to a widely held and oversimplified belief or perception about certain groups of people, often based on characteristics such as gender or ethnicity, that can lead to biases in scientific research, education, or practice. This is harmful because they lead to biases that hinder the progress of scientific inquiry and limit opportunities for individuals from underrepresented groups.

Stereotypes About Abilities influence how individuals are in - or excluded from scientific activities and research.

Gender Stereotypes in science can lead to gender bias in STEAM fields.

Age Stereotypes have impact on opportunities for research funding, career advance-ment, and collaboration.

Cultural Stereotypes may affect how certain cultures' contributions to science are acknowledged or overlooked.

Racial and Ethnic Stereotypes can influence research funding, career opportunities, and educational experiences.

MEASURABLE GOALS, IMPACT & DATA

Empirical research at the community level holds immense relevance when it comes to assessing the tangible impact of centrally decided strategies and actions. It serves as a powerful tool to map the real needs of communities and to show the effectiveness of overarching decisions.

There is still an undeniable challenge that persists in the area of decision-making: Communities in vul-nerable risk situations, while an essential part of diverse communities, are often left out of key decision-making processes. The underrepresentation of people who face discrimination when it comes to gender stereotypes or people with disabilities remains a harsh reality. Even when policymakers have the best of intentions, their initiatives are often not effective in meeting the real needs of the community.

In this complicated process of community development, evaluation proves to be the guiding compass to achieve realistic goals. Evaluation is not just about measuring outcomes, but also about char-ting the path of transformation toward meaningful change. In this context, as already mentioned in the policiymaker level, a simple basic strategy can be followed that is variable and adaptable in its individual stepstones.

During the pilot phases at C4S, we sought to understand evaluation as an integral part of our community strategy in order to make informed decisions. This can more effectively channel efforts and spur the kind of positive change that can only come from a deep understanding of community dynamics. Through evaluation, you can continually refine and improve your initiatives to ensure they are always aligned with the evolving needs of the community you serve.

INCLUSION CHECKLIST

We have compiled a step-by-step guide based on our experience that can be easily adapted and, in a best-case scenario, lead to the implementation of inclusive goals and their optimization.

Establish clear EVALUATION OBJECTIVES	Begin by setting specific and well-defined objectives for the evaluation process. Determine what aspects you want to assess, measure, or gain insights into, and ensure that these objectives are aligned with the broader goals of your community strategy.
Select RELEVANT INDICATORS	Identify key performance indicators (KPIs) and metrics that are closely tied to your strategy's goals and activities to provide meaningful data for assessing progress and success.
Collect BASELINE DATA	Before implementing your strategy, gather baseline data. This initial data serves as a reference point, allowing you to measure changes and impacts accurately as you progress.
Mix QUALITATIVE & QUANTITATIVE Data	Employ combinations of qualitative and quantitative data collection methods. While numerical data is valuable, insights from surveys, interviews, focus groups and observations can provide a more comprehensive view.
ENGAGE STAKEHOLDERS	Involve community members, partners, and stakeholders in the evaluation process. Seek their input on aspects such as evaluation design, data collection, and interpretation to ensure a well-rounded perspective.
REGULAR Data collection	Implement a consistent schedule for data collection, tailored to your strategy's needs. Regular data collection helps monitor trends and track progress effectively.
Data QUALITY ASSURANCE	Prioritize data quality by adequately training data collectors, conducting periodic quality checks, and utilizing standardized data collection tools. Reliable data is essential for meaningful evaluation.
ANALYSIS & INTERPRETATION	Analyze collected data systematically to identify trends, patterns and insights. Interpret the results within the context of your strategy's goals and objectives.
COMPARE against BENCHMARKS	Measure your data against baseline measurements or benchmarks established during the strategy's development phase to gauge the extent of change and progress achieved.
FEEDBACK LOOPS	Establish feedback loops with community members and stakeholders. Share evaluation findings with them and actively seek their input on how to enhance or adjust the strategy based on the results.
MID - TERM ASSESSMENTS	Consider conducting mid-term evaluations to assess progress and make necessary adjustments. This approach addresses challenges or seize opportunities before the strategy's conclusion.
OUTCOME ASSESSMENTS	Go beyond evaluating outputs (quantitative results) and delve into assessing outcomes (qualitative impacts). Measure the real-world changes and improvements stemming from your strategy.
COST BENEFIT Analysis	Evaluate the cost-effectiveness and efficiency of your strategy. Compare the resources invested with outcomes achieved to determine if any adjustments are needed.
REPORT TRANSPARENTLY	Transparently communicate evaluation findings with the community. Provide accessible and easily understandable reports that highlight successes and areas requiring improvement.
FEEDBACK INCORPORATION	Act upon the insights gleaned from the evaluation. Utilize the findings to make informed decisions, refine strategies and implement improvements in real-time.
CONTINUOUS Learning	Approach evaluation as an ongoing learning process. Foster a culture of continuous learning and adaptation based on the results obtained.

SUPERVISION, RESILIENCE & EMPOWERMENT

In our pursuit of inclusive education, we often encounter barriers that pose a great challenge to our motivation and engagement. These barriers affect all levels and extend far beyond the classroom into the macro structures of our society. **Inclusive education requires determination. It affects not only families as a construct, but also individuals.** The right to a quality education must be supported at all levels, even when economic constraints and regulations present enormous obstacles. **People who face limitations in participating in organized events and activities can feel discouraged, but this is also where resilience can develop.** Bridging this gap requires building connections and partnerships with agencies and opening doors to activities that support or serve people from diverse communities. In some cases, it may even be necessary to provide activities directly on site.

What is essential at this point is that science and the level at which it impacts and comes to fruition affects a privileged percentage of our society. For people from this social class, it is often difficult to think outside the box. It is "normal" to have access to education and opportunities. It is important to have a goal, prosperity, and success.

When you talk about inclusive education for all, you start from your own point of view, needs that you have been taught since childhood. But these things are simply different for people from other communities. It is difficult to recognize other realities of life. Cognitively, you can grasp them. But how can you really understand something if you have no idea about other perspectives.

Supervision can be a first step toward a broader perception. Supervision can be many things:

Supervision is also important in the field of social workers. Resilience is a necessity, but even if you are accompanied when in challenging situations, it is nevertheless possible to encounter emotional situations that can also have a massive impact on your own mental health. This is where support needs to be expanded and can be provided directly by policymakers and with targeted funding that is quickly available without great administrative hurdles or long waiting times.

SHOUT OUT LOUD

In a plural and diverse society, equal opportunities for all are essential to avoid discrimination, exclusion, and segregation. Equity should play a central role also in education-related areas, not only in terms of transmitting equity values to children but also to implement them on site (e.g., by promoting also a plural workforce, by seeking science representatives from different backgrounds when conducting science educational activities, by listening to the voices of educators from the local communities, by boosting new pedagogical strategies, promoting multiple enriching identities, interests, and competences within the school groups, etc.). Thus, to conduct an inclusive science approach is not only a matter of changing the science content, it is also essential to act de facto at an practical institutional level to boost equity and pluralism in the actual sites where children will learn and discover the world.

Enhance inclusion by incorporating and boosting plural teams.	Strengthen engagement by boosting public forums on ISE topics.	Engage in outreach and Outdoor activities to foster more accessibility

ROOM FOR MORE IDEAS:

Empowerment is not just a concept, but a call to action.

QUOTES FOR CHANGE

LEARN FROM EXPERIENCE & LET YOURSELF BE INSPIRED

MAG. FERI JANOSKA

„Inclusion is crucial for minorities because it means that every voice is heard, regardless of ethnic background, origin, religion, gender, or identity. Structural changes need to take place not only at the policy level, but also in people's minds to ensure that no one is left alone on the margins of society. When the individual as a holistic human being becomes the focus of consideration and effort, we can create a more inclusive and diverse world where everyone can reach their full potential."

AB Member, Educator and chairman of Roma VHS

MARKUS RUMELHART

„In our pursuit of harmonious coexistence, we are placing an increased focus on communities in vulnerable risk situations in Vienna's 6th District in order to represent the diversity of the population in its full range. Awareness and equality, especially in education, contribute to a positive community, especially in densely populated areas. A wonderful example of this is our annual "andersrum ist nicht verkehrt"* street festival, where visitors can experience firsthand how diversity enriches us."

** Literal translation: "The other way around is not wrong."*
District Head in the 6th District of Vienna

MAG. MARKUS HALL

„Inclusion must be institutionalized. In many cases, the history of museums in particular has questionable backgrounds. But not only that, curatorial practice must be rethought, knowledge transfer must be redesigned and didactically prepared. Accessibility means holistic attentiveness and can only be implemented inclusively if it is carried out and lived by plural teams. "

Dialog Marketing, Leopoldmuseum Vienna

ZEHRA ÖZ

"As a teacher, nurturing a classroom that embraces inclusive science education is like planting seeds of curiosity; watch them grow into forests of discovery and understanding."

Primary school teacher, Lecturer in Media Arts

SVEN

„You have to believe in the children and their potential.
Not thinking they are too young; they can't do this."

"The way the teacher looks at children; the teacher's belief in children is crucial, no matter what context they grow up in. The teacher must have the will to get to know each child's uniqueness well."

Pilot teacher Brussels Hub, June 2022

LITERATURE REVIEW & RECOMMENDATIONS

Find useful documents and publications that provide further information on topics already mentioned or for in-depth research. Many of these documents have provided us with valuable know-how for our work and form a solid basis for this project.

- **C4S Report on Literature Report (2022). Communities for Sciences. http://www.communities-for-sciences.eu/wp-content/uploads/2022/09/Attachment_0-5.pdf**

- European Parliament resolution of 15 April 2015 on the occasion of International Roma Day — anti-Gypsyism in Europe and EU recognition of the memorial day of the Roma genocide during World War II (2015/2615(RSP). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52015IP0095

- Fletcher, T. S., Blake, A. B., & Shelffo, K. E. (2018). Can Sensory Gallery Guides for Children With Sensory Processing Challenges Improve Their Museum Experience? Journal of Museum Education, 43(1), 66-77. http://dx.doi.org/10.1080/10598650.2017.1407915

- King Miller, B. A. (2017). Navigating STEM: Afro Caribbean Women Overcoming Barriers of Gender and Race. SAGE Open, 7(4), 215824401774268. https://doi.org/10.1177/2158244017742689

- LaForce, M. & Zuo, H.& Ferris, K. & Noble, E. (2019). Revisiting Race and Gender Differences in STEM: Can Inclusive STEM High Schools Reduce Gaps? European Journal of STEM Education, 4(1), 08. https://doi.org/10.20897/ejsteme/5840

- Maina-Okori, N. M., Koushik, J. R., & Wilson, A. (2018). Reimagining intersectionality in environmental and sustainability education: A critical literature review. The Journal of Environmental Education, 49(4), 286-296. https://doi.org/10.1080/00958964.2017.1364215

- Murray, M. M., Mereoiu, M., Cassidy, D., Vardell, R., Niemeyer, J. A., & Hestenes, L. (2016). Not Black Like Me: The Cultural Journey of an Early Childhood Program. Early Childhood Education Journal, 44(5), 429-436. https://doi.org/10.1007/s10643-015-0731-4

- OECD. (2020). OECD Education Working Paper No. 228: Inclusion of Roma Students in Europe: A literature review and examples of policy initiatives. OECD. https://www.oecd-ilibrary.org/education/inclusion-of-roma-students-in-europe_8ce7d6eb-en

- UNHCR (2017). Main curriculum about refugees, asylum and migration. UNHCR. https://www.unhcr.org/59d354967

- UNICEF (2011). The Right of Roma Children to Education: Position Paper. Geneva: UNICEF Regional Office for Central and Eastern Europe and the Commonwealth of Independent States (CEECIS).

- Winter, J. (2018). Wangari's Trees of Peace (2nd ed.). HMH Books for Young Readers. https://www.goodreads.com/work/best_book/4056408-wangari-s-trees-of-peace-a-true-storyfrom-africa

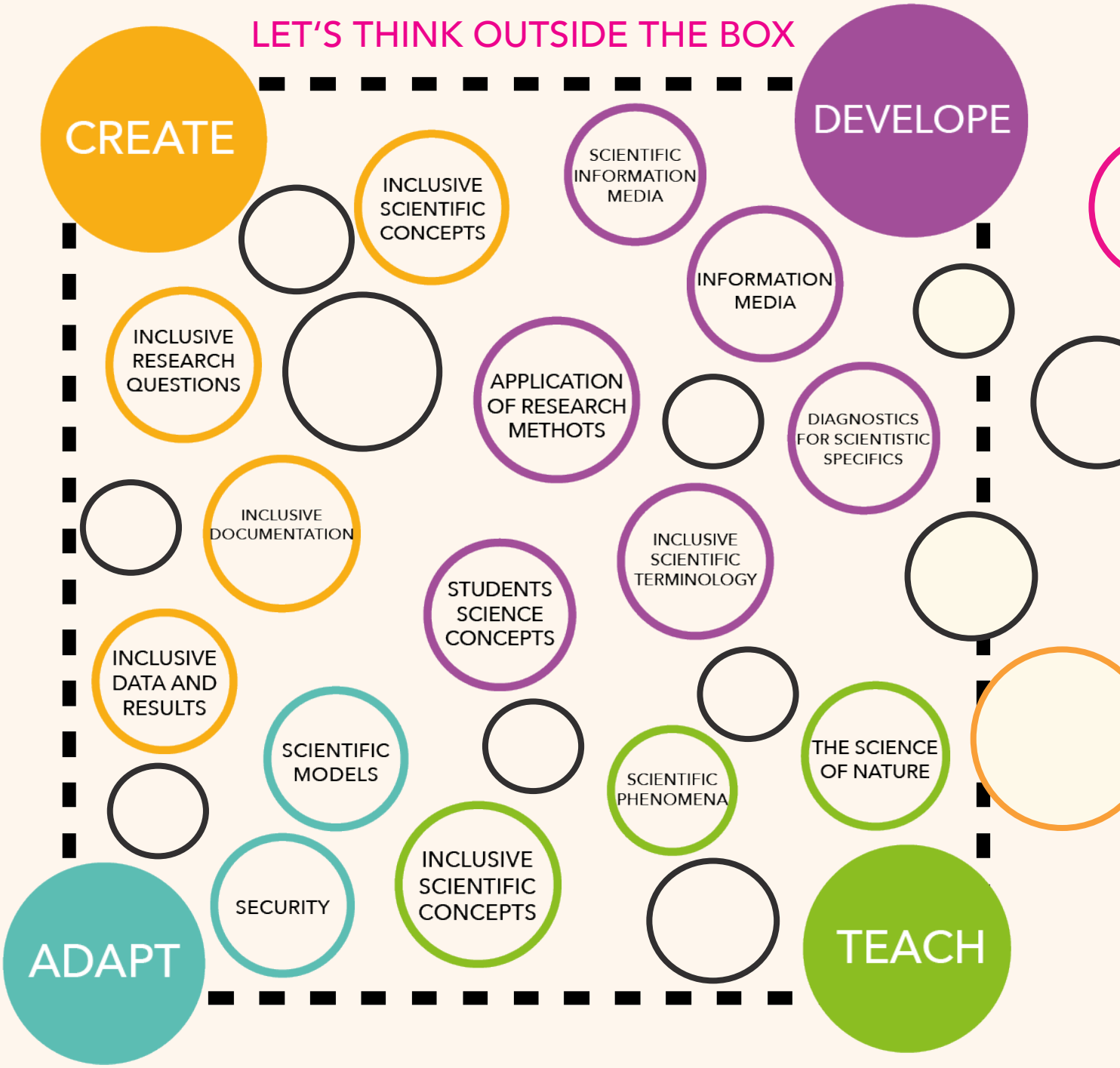
CALL TO ACTION

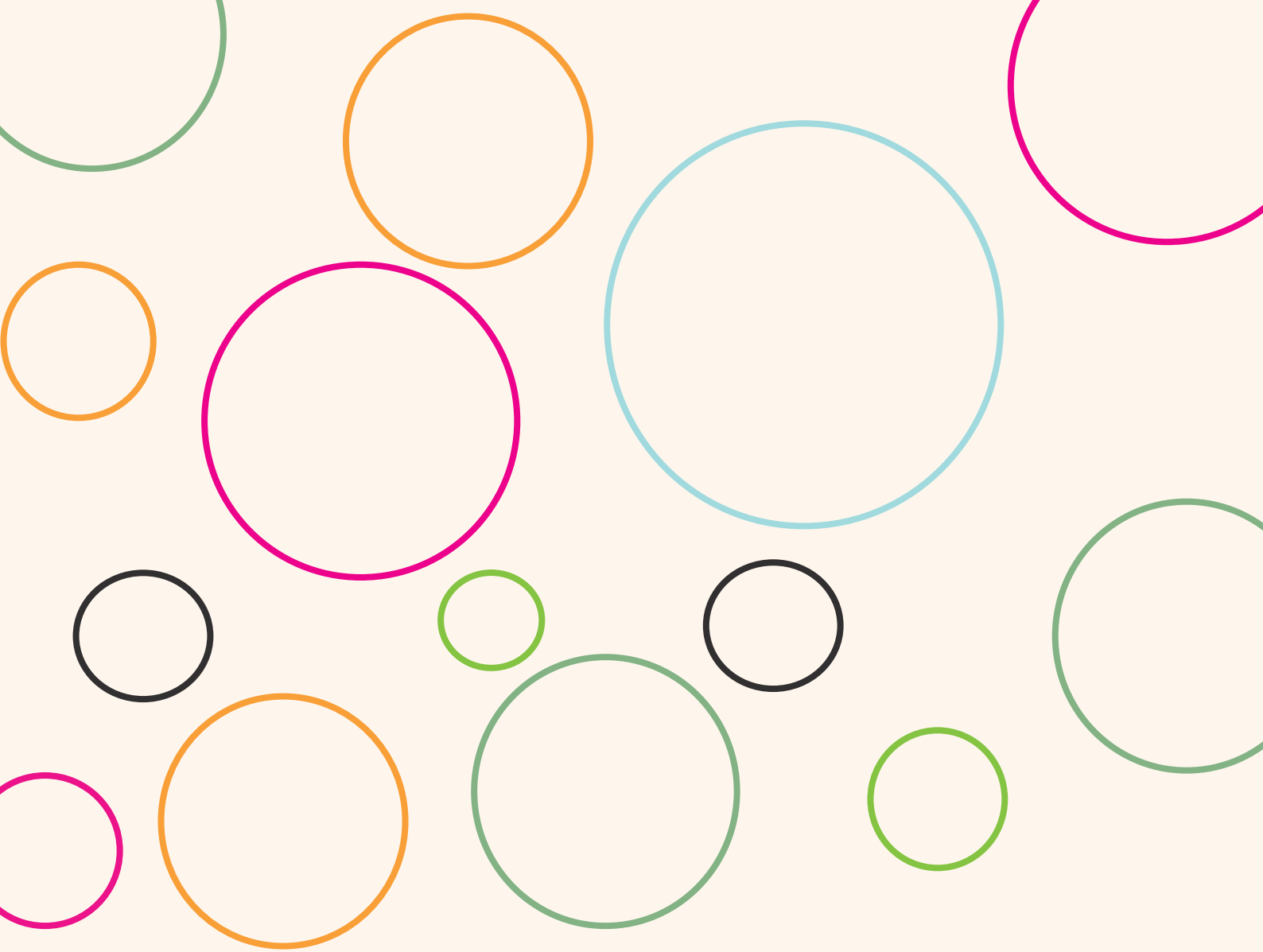
LET'S BUILD A BRIGHTER FUTURE

Policymakers, practitioners, and communities: Let's come together and create a transformative change in science education. Recognize the power of diversity, inclusion, and the limitless potential that lies within our diverse communities.

We have to remember that our journey toward inclusive science education is a continuous one. It requires dedication, collaboration, and a shared commitment to growth. The challenges that lie ahead of us are opportunities and possibilities for learning and improvement. We can build a future in which every student has equal opportunities to engage, explore, and participate in science education. We should strive to develop inclusive practices, create supportive environments, and foster a love of science in the hearts and minds of our learners.

But where to start? Who are the target groups?
Is there statistical data?
Are there specific categories that need to be prioritized for inclusion in science education?





The most important thing is the will to start. The next steps depend on your environment, your setting, your country.... There is not THE COMMUNITY that is particularly important for inclusion. Inclusion, education, and science matter to us as a whole society, it just differs on an individual level. For all of us, there are different priorities, desires and needs. Some people are privileged and don't have to think about what it means NOT to be able to get an education, because on a structural level there are barriers due to an underlying characteristic. Many people do not have the opportunity. Where to start depends on your position and your environment:

Policymakers, let's design and implement policies that promote equitable access, foster inclusive environments, and support the development of ISE programs. By investing in resources, training, and infrastructure, practitioners and communities are empowered to provide engaging and meaningful experiences for students.

Practitioners, let's expand our pedagogical repertoire, continue with learning and embrace innovative teaching methods that cater to diverse learning needs. Let's work on creating classrooms in which every voice is valued and every student feels a sense of belonging and empowerment.

Communities, let's join hands to break down barriers and celebrate the richness of our collective knowledge. By actively engaging in science educational initiatives, the next generation of scientists, engineers, and innovators are inspired and passionate about exploring the wonders of the scientific world.

THE TIME IS NOW. THIS JOURNEY IS DRIVEN BY COLLECTIVE PASSION FOR INCLUSIVE SCIENCE EDUCATION AND THE CHANCE TO UNLOCK OUR FULL POTENTIAL AND CONTRIBUTE TO THE SCIENTIFIC ADVANCEMENTS THAT WILL SHAPE OUR FUTURE.

Abels S. (2015). "Implementing Inquiry-Based Science Education to Foster Emotional Engagement of Special-Needs Students". In Kahveci M., Orgill M. (eds). Affective Dimensions in Chemistry Education. Springer, Berlin, Heidelberg, pp. 107-131.

Bambra, C., Albani, V., & Franklin, P. (2021). "COVID-19 and the gender health paradox". Scandinavian Journal of Public Health, 49(1), 17–26. https://doi.org/10.1177/1403494820975604

Barouki, R., Kogevinas, M., Audouze, K., Belesova, K., Bergman, A., Birnbaum, L., Boekhold, S., Denys, S., Desseille, C., Drakvik, E., Frumkin, H., Garric, J., Destoumieux-Garzon, D., Haines, A., Huss, A., Jensen, G., Karakitsios, S., Klanova, J., Koskela, I.-M., … HERA-COVID-19 working group. (2021). "The COVID-19 pandemic and global environmental change: Emerging research needs". Environment International, 146, 106272. https://doi.org/10.1016/j.envint.2020.106272

Boisselle, L.N. (2016). Decolonizing Science and Science Education in a Postcolonial Space (Trinidad, a Developing Caribbean Nation, Illustrates). SAGE Open, 6(1). https://doi.org/10.1177/2158244016635257

Brauns S., Abels S. (2020). The Framework for Inclusive Science Education. Working Paper, n. 1/2020, Leuphana University Luneburg, Science Education, Inclusive Science Education (ISSN 2701-3766). www.leuphana.de/inclusive-science-education

Burke, L. E. (2020). Informal science educators and children in a low-income community describe how children relate to out-of-school science education. International Journal of Science Education, 42(10), 1673-1696. https://doi.org/10.1080/09500693.2020.1774936

C4S (2022). D4.1 – Report on literature review. http://www.communities-for-sciences.eu/wp-content/uploads/2022/09/Attachment_0-5.pdf

Chalmers, A.F. (2015). ¿Qué es esa cosa llamada ciencia? Madrid:ed. Siglo XXI

Chalufour, I., & Worth, K. (2003). Discovering Nature with Young Children (1st ed.). Redleaf Press. https://www.redleafpress.org/Discovering-Nature-with-Young-Children-Teachers-Guide-P62.aspx

Chaudhury, S. (2021). Anthropology of Covid-19: Some narratives. The Eastern Anthropologist, 74(2–3), 175–185.

Cheah, C. S. L., Wang, C., Ren, H., Zong, X., Cho, H. S., & Xue, X. (2020). COVID-19 Racism and mental health in Chinese American families. Pediatrics, 146(5), e2020021816. https://doi.org/10.1542/peds.2020-021816

COM(2008) Green Paper: Migration & mobility: Challenges and opportunities for EU education systems. Commission of the European Communities. Brussels, 03/07/2008.COM(2008) 423 final. https://op.europa.eu/en/publication-detail/-/publication/7a1f2071-3a01-4ced-aee9-dbf9310f6da3/language-en

Davies, D., Howe, A., Collier, C., Digby, R., Earle, S., & McMahon, K. (2014). Teaching Science and Technology in the Early Years (3-7) (3rd ed.). Routledge. https://www.routledge.com/Teaching-Science-and-Technology-in-the-Early-Years-3-7/Davies-Howe-Collier-Digby-Earle-McMahon/p/book/9780415825597

De Paz, C., Munoz Boudet, A. M., & Gaddis, I. (2020). Gender dimensions of the COVID-19 pandemic. World Bank Group. https://openknowledge.worldbank.org/bitstream/handle/10986/33622/Gender-Dimensions-of-the-COVID-19-Pandemic.pdf?sequence=1%26isAllowed=y

Devakumar, D., Shannon, G., Bhopal, S. S., & Abubakar, I. (2020). Racism and discrimination in COVID-19 responses. The Lancet, 395(10231), 1194. https://doi.org/10.1016/S0140-6736(20)30792-3

Dewey, J. (2004). Democracia y Educación. Madrid: Morata

Djonko-Moore, C. M., Leonard, J., Holifield, Q., Bailey, E. B., & Almughyirah, S. M. (2018). Using Culturally Relevant Experiential Education to Enhance Urban Children's Knowledge and Engagement in Science. Journal of Experiential Education, 41(2), 137-153. https://doi.org/10.1177/1053825917742164

Duster, T. (2005). Race and Reification in Science. Science, 307(5712), 1050–1051. https://doi.org/10.1126/science.1110303 Fuentes, A., Ackermann, R. R., Athreya, S., Bolnick, D., Lasisi, T., Lee, S.-H., McLean, S.-A., & Nelson, R. (2019). AAPA Statement

Elias, A., Ben, J., Mansouri, F., & Paradies, Y. (2021). Racism and nationalism during and beyond the COVID-19 pandemic. Ethnic and Racial Studies, 44(5), 783–793. https://doi.org/10.1080/01419870.2020.1851382

European Commission (2019). Eurydice Report - Integrating Students from Migrant Backgrounds Education and Training into Schools in Europe, National Policies and Measures. Brussels: Education, Audiovisual and Culture Executive Agency. https://eurydice.eacea.ec.europa.eu/publications/integrating-students-migrant-backgrounds-schools-europe-national-policies-and-measures

European Commission, Directorate-General for Research and Innovation, Science education for responsible citizenship : report to the European Commission of the expert group on science education, Publications Office, 2015, https://data.europa.eu/doi/10.2777/12626

European Commission, Directorate-General for Education, Youth, Sport and Culture, Investing in education in a post-Covid EU, Publications Office of the European Union, 2022, https://data.europa.eu/doi/10.2766/690624

European Commission (2023) Investing in Education 2023, Luxembourg: Publications Office of the European Union, 2023, doi 10.2766/529409

Feyerabend, P. K. (1989). Límites de la ciencia – Explicación, reducción y empirismo. Barcelona: Paidós

Fore, H. H. (2020). A wake-up call: COVID-19 and its impact on children's health and wellbeing. Lancet Global Health, 8(7), e861–e862. https://doi.org/10.1016/S2214-109X(20)30238-2

Freinet, C. (1975). La formació de la infància i la joventut.Barcelona: BEM

Funtowicz, S.O. & Ravetz, J.R. (2000). La ciencia posnormal.Barcelona : Icaria

Gupta, S., & Jawanda, M. K. (2020). The impacts of COVID-19 on children. Acta Paediatrica, 109(11), 2181–2183. https://doi.org/10.1111/apa.15484

Hall, K. S., Samari, G., Garbers, S., Casey, S. E., Diallo, D. D., Orcutt, M., Moresky, R. T., Martinez, M. E., & McGovern, T. (2020). Centring sexual and reproductive health and justice in the global COVID-19 response. The Lancet, 395(10231), 1175–1177. https://doi.org/10.1016/S0140-6736(20)30801-1

Harlen, W. (2010). Principles and big ideas of Science Education. Gosport: Ashford Colour Press. https://www.ase.org.uk/bigideas

Intern-Agency Standig Commitee (IASC). (2020). Addressing mental health and psychosocial aspects of COVID-19 outbreak. https://interagencystandingcommittee.org/iasc-reference-group-mental-health-and-psychosocial-support-emergency-settings/interim-briefing-note-addressing-mental-health-and-psychosocial-aspects-covid-19-outbreak

Karalis Noel, T. (2020). Conflating culture with COVID-19: Xenophobic repercussions of a global pandemic. Social Sciences & Humanities Open, 2(1), 100044. https://doi.org/10.1016/j.ssaho.2020.100044

King Miller, B. A. (2017). Navigating STEM: Afro Caribbean Women Overcoming Barriers of Gender and Race. SAGE Open, 7(4), 215824401774268. https://doi.org/10.1177/2158244017742689

Koyré, A. (1994). Pensar la Ciencia. Barcelona: Paidós

Kuhn, Th. S. (2013). La estructura de las Revoluciones científicas. Madrid: Fondo de Cultura económica

LaForce, M. & Zuo, H.& Ferris, K. & Noble, E. (2019). Revisiting Race and Gender Differences in STEM: Can Inclusive STEM High Schools Reduce Gaps? European Journal of STEM Education, 4(1), 08. https://doi.org/10.20897/ejsteme/5840

Laster Pirtle, W. N. (2020). Racial capitalism: A fundamental cause of novel coronavirus (COVID-19) pandemic inequities in the United States. Health Education & Behavior, 47(4), 504–508. https://doi.org/10.1177/1090198120922942

Lemkow–Tovías, G., Lemkow, L., Cash-Gibson, L., Teixidó-Compañó, E., & Benach, J. (2022). Impact of COVID-19 inequalities on children: An intersectional analysis. Sociology of Health & Illness, 1–18. https://doi.org/10.1111/1467-9566.13557

Logie, C. H., & Turan, J. M. (2020). How do we balance tensions between COVID-19 public health responses and stigma mitigation? Learning from HIV research. AIDS and Behavior, 24(7), 2003–2006. https://doi.org/10.1007/s10461-020-02856-8

Lokot, M., & Avakyan, Y. (2020). Intersectionality as a lens to the COVID-19 pandemic: Implications for sexual and reproductive health in development and humanitarian contexts. Sexual and Reproductive Health Matters, 28(1), 1764748. https://doi.org/10.1080/26410397.2020.1764748

Maina-Okori, N. M., Koushik, J. R., & Wilson, A. (2018). Reimagining intersectionality in environmental and sustainability education: A critical literature review. The Journal of Environmental Education, 49(4), 286-296. https://doi.org/10.1080/00958964.2017.1364215

Nazroo, P. J., Murray, K., Taylor, H., Bécares, D. L., Field, Y., Kapadia, D. D., & Rolston, D. Y. (2020). Rapid evidence review: Inequalities in relation to COVID-19 and their effects on London. 80.

OECD. (2021). Towards gender-inclusive recovery. OECD. https://doi.org/10.1787/ab597807-en

Osborne, J. (2014). "Teaching Scientific Practices: Meeting the Challenge of Change.", Journal of Science Teacher Education, n. 25, pp. 177-196

Park, C.-Y., & Inocencio, A. M. (2020). COVID-19 is No excuse to regress on gender equality. (0 ed., ADB Briefs) [ADB Briefs]. Asian Development Bank. https://doi.org/10.22617/BRF200317-2

Patnaik, S. M. (2021). Managing the COVID-19 pandemic in odisha: Anthropological reflections. The Eastern Anthropologist, 74(2–3), 159–171.

Pedreira, M. (2015). "Niu de Ciència, espacio de educación científica para niños.", Museologia e patrimonio, vol. 8, n.1, pp. 9-29

Peterman, A., & O'Donnell, M. (2020). COVID-19 and violence against women and children. 11.

Royal Society (2019). Diversity strategy 2019-2022. https://royalsociety.org/-/media/policy/topics/diversity-in-science/2019-09-Diversity-strategy-2019-22.pdf?la=en-GB&hash=3C2C52DE55E915B-0FC394A05400ACFFB#:~:text=The%20strategy%20for%202019%20%E2%80%93%202022,a%20more%20inclusive%20scientific%20community.

Royal Society of Chemistry (2018). Diversity landscape of the chemical sciences - A report by the Royal Society of Chemistry. Cambridge: Royal Society of Chemistry. https://www.rsc.org/globalassets/02-about-us/our-strategy/inclusion-diversity/cm-044-17_a4-diversity-landscape-of-the-chemical-sciences-report_web-2.pdf

Saini, A. (2021). Superior – El retorno del racism científico. Madrid: Círculo de Tiza.

Save the Children. (2020). Adolescent girls and COVD-19: GBV risks and response. https://socialprotection.org/es/discover/publications/adolescent-girls-and-covid-19-gbv-risks-and-response

Shapin, S. (2000). La revolución científica- Una interpretación alternativa. Barcelona: Paidós

Sontag, S. (2020). La enfermedad y sus metáforas. El sida y sus metáforas. Barcelona: Penguin Random House

Tasnim, S., Hossain, M. M., & Mazumder, H. (2020). Impact of rumors or misinformation on coronavirus disease (COVID-19) in social media. In SocArXiv (No. uf3zn; SocArXiv). Center for Open Science. https://ideas.repec.org/p/osf/socarx/uf3zn.html

Trilla, J. (coord..) et al. (2001). El legado pedagógico del siglo XX para la escuela del Siglo XXI. Barcelona: Graó

Salasan Consulting Inc. (2020). Addressing gendered on sequences of COVID-19 in education and training. Commonwealth of Learning. http://oasis.col.org/bitstream/handle/11599/3725/2020_Salasan_Gendered_Consequences_COVID.pdf?sequence=1%26isAllowed=y

Stoichita, V.I. (2016). La imagen del otro – negros judíos . musulmanes y gitanos en el arte occidental en los albores de la Edad Moderna. Madrid: ed. Cátedra

UNESCO (2017). A guide for ensuring inclusion and equity in education.. Paris: UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000248254

UNESCO (2008). Defining an Inclusive education Agenda: Reflections around the 48th Session of the International Conference on Education. Geneva: UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000186807

United Nations (1995). Beijing Declaration and Platform for Action - The Fourth World Conference on Women. Beijing: UN. https://www.un.org/womenwatch/daw/beijing/pdf/BDPfA%20E.pdf

United Nations. (2020). Policy brief: The impact of COVID-19 on women. United Nations Entity for Gender Equality and the Empowerment of Women. https://www.unwomen.org/-/media/headquarters/attachments/sections/library/publications/2020/policy-brief-the-impact-of-covid-19-on-women-en.pdf?la=en%26vs=1406

UN WOMEN. (2020). COVID-19 and ending violence against women and girls. United Nations Entity for Gender Equality and the Empowerment of Women. https://www.unwomen.org/-/media/headquarters/attachments/sections/library/publications/2020/issue-brief-covid-19-and-ending-violence-against-women-and-girls-en.pdf?la=en%26vs=5006

Virdee, S., & McGeever, B. (2018). Racism, crisis, Brexit. Ethnic and Racial Studies, 41(10), 1802–1819. https://doi.org/10.1080/01419870.2017.1361544

Wang, S., Chen, X., Li, Y., Luu, C., Yan, R., & Madrisotti, F. (2021). 'I'm more afraid of racism than of the virus!': Racism awareness and resistance among Chinese migrants and their descendants in France during the Covid-19 pandemic. European Societies, 23(sup1), S721–S742. https://doi.org/10.1080/14616696.2020.1836384

World Health Organization. (2008). Closing the gap in a generation: Health equity through action on the social determinants of health: Commission on social determinants of health final report. World Health Organization. https://books.google.es/books?hl=ca%26lr=%26id=zc_VfH7wfV8C%26oi=fnd%26pg=PA1%26dq=Commission+on+Social+Determinants+of+Health.+Closing+the+gap+in+a+generation:+health+equity+through+action+on+the+social+determinants+of+health.%26ots=4v5iDjVamE%26sig=lDDRnCV2frzibw-JG4X_wfKtPds

Communities for Sciences

11 partners

08 countries

06 hubs

03 years

This White Book is founded on the theoretical framework of inclusive science education (ISE) developed throughout the C4S project. It incorporates the outcomes derived from the pilot activities carried out in eight EU countries. All recommendations are drawn from experiences obtained in the local C4S Hubs after working with communities, schools and policymakers. These Hubs, with their pilots play the central role in advancing the C4S initiative for inclusive and equitable science education together to effect meaningful change.

facebook

home

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No.872104