



Communities for Sciences

Towards Promoting an Inclusive Approach in Science Education

D2.3 - White Book on Inclusive Science Education

Project Acronym	C4S
Project Name	Communities for Science – Towards Promoting an Inclusive Approach in Science Education
Grant Agreement	872104
Start date of the project	01/10/2020
End date of the project	30/11/2023
Related Work Package	WP2
WP Lead Partner	RCE Vienna
Other Partner(s) involved	FUB, UNIMIB, EhB, Galileo, IB, LU, NBU
Deliverable identifier	D2.3
Deliverable lead beneficiary	RCE Vienna
Due date	30.09.2023
Date of delivery	30.09.2023
Version	Version V3.0
Author	RCE Vienna
Classification	Public

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 872104



REVISION HISTORY			
Revision	Date	Comments	Author
	20.10.2022	Working Group Session: Focus: concept & structure	Irene Glockengießer (RCE) Anna-Maria Krulis (RCE) Marleen Rosiers (EhB) Gabriel Lemkow (FUB) Miryam Navarro (FUB) Lyudmyla Kokorina (FUB) Maria Lluïsa Sort García (FUB) Kristina Orban (LU) Sarah Scheer (IB) Petar Lefterov (UNIMIB) Valeria Cotza (UNIMIB) Nadia Koltcheva (NBU) Penka Hristova (NBU) Claudia Piovano (Galileo) Sarolta Darvay (Galileo)
V0.01	25.10.2022	Concept & Structure	Irene Glockengießer (RCE) Anna-Maria Krulis (RCE)
	16.11.2022	Working Group Session, Focus: index & structure	Irene Glockengießer (RCE) Anna-Maria Krulis (RCE) Marleen Rosiers (EhB) Gabriel Lemkow (FUB) Miryam Navarro (FUB) Maria Lluïsa Sort García (FUB) Lyudmyla Kokorina (FUB) Petar Lefterov (UNIMIB) Valeria Cotza (UNIMIB) Nadia Koltcheva (NBU) Claudia Piovano (Galileo) Sarolta Darvay (Galileo)
V0.02	07.12.2022	Index & Structure	Irene Glockengießer (RCE) Anna-Maria Krulis (RCE) Gabriel Lemkow (FUB)
	10.12.2022	Feedback (external)	Andrea Neuhauser (HAUP) Martin Scheuch (HAUP)
	13.12.2022	Working Group Session, Focus: levels & visual concept	Irene Glockengießer (RCE) Anna-Maria Krulis (RCE) Gabriel Lemkow (FUB) Lyudmyla Kokorina (FUB) Miryam Navarro (FUB)



			Sarah Scheer (IB) Marleen Rosiers (EhB) Petar Lfterov (UNIMIB) Valeria Cotza (UNIMIB) Nadia Koltcheva (NBU)
	18.01.2023	Working Group Session, Focus: policy maker & practitioner level	Irene Glockengießer (RCE) Anna-Maria Krulis (RCE) Marleen Rosiers (EhB) Claudia Piovano (Galileo) Sarah Scheer (IB) Valeria Cotza (UNIMIB) Antoaneta Mateeva (NBU)
V0.03	20.01.2023	First Draft White Book	Irene Glockengießer (RCE) Gabriel Lemkow (FUB)
	26.01.2023	Working Group Session, Focus: community level	Irene Glockengießer (RCE) Gabriel Lemkow (FUB) Miryam Navarro (FUB) Marleen Rosiers (EhB) Petar Lfterov (UNIMIB) Valeria Cotza (UNIMIB) Nadia Koltcheva (NBU) Claudia Piovano (Galileo)
V0.04	29.01.2023	First Draft White Book	Irene Glockengießer (RCE) Petar Lfterov (UNIMIB) Gabriel Lemkow (FUB) Marleen Rosiers (EhB)
	02.02.2023	Working Group Session, Focus: first draft	Miryam Navarro (FUB) Gabriel Lemkow (FUB) Claudia Piovano (Galileo) Sarah Scheer (IB) Antoaneta Mateeva (NBU)
V0.05	10.03.2023	Revision	Irene Glockengießer (RCE) Gabriel Lemkow (FUB) Marleen Rosiers (EhB) Petar Lfterov (UNIMIB)
	14.03.2023	Working Group Session, Focus: Roadmaps	Irene Glockengießer (RCE) Anna-Maria Krulis (RCE) Marleen Rosiers (EhB) Gabriel Lemkow (FUB) Claudia Piovano (Galileo) Petar Lfterov (UNIMIB) Martin Wildenberg (external)
V0.06	24.3.2023	Revision	Irene Glockengießer (RCE)



	27.03.2023	Working Group Session	Irene Glockengießer (RCE) Marleen Rosiers (EhB) Gabriel Lemkow (FUB) Claudia Piovano (Galileo) Petar Lefterov (UNIMIB) Valeria Cotza (UNIMIB)
V0.07	20.04.2023	Revision	Irene Glockengießer (RCE) Gabriel Lemkow (FUB)
	21.04.2023	Working Group Session	Gabriel Lemkow (FUB) Sarah Scheer (IB) Kristina Orban (LU) Claudia Piovano (Galileo)
V0.08	04.05.2023	Revision	Gabriel Lemkow (FUB) Sarah Scheer (IB) Kristina Orban (LU) Claudia Piovano (Galileo)
	05.05.2023	Working Group Session	Irene Glockengießer (RCE) Anna-Maria Krulis (RCE) Kristina Orban (LU) Gabriel Lemkow (FUB) Maria Lluïsa Sort García (FUB) Antoaneta Mateeva (NBU)
V0.09	22.05.2023	Revision	Irene Glockengießer (RCE)
	25.05.2023	Co-Working Session at GA, Focus: recommendations all levels	Luisa Zecca (UNIMIB) Valeria Cotza (UNIMIB) Petar Lefterov (UNIMIB) Gabriel Lemkow (FUB) Maria Lluïsa Sort García (FUB) Miryam Navarro (FUB) Alessandro Porcheddu (Giocheria) Alessandra Barbanti (Giocheria) Marta Granata (Giocheria) Kristina Orban (LU) Marleen Rosiers (EhB) Nadia Koltcheva (NBU) Penka Hristova (NBU) Antoaneta Mateeva (NBU) Adam Fekete (Galileo) Sarolta Darvay (Galileo) Marlis Henner (EB)



			Irene Glockengießer (RCE) Anna-Maria Krulis (RCE)
V0.10	17.06.2023	White Book final draft	Irene Glockengießer (RCE)
V0.11	04.07.2023	Revision	Anna-Maria Krulis (RCE) Gabriel Lemkow (FUB) Maria Lluïsa Sort García (FUB) Petar Lefterov (UNIMIB) Claudia Piovano (Galileo) Sarah Scheer (IB)
V1.0	06.07.2023	White Book V1	Irene Glockengießer (RCE)
V1.0	11.09.2023	Feedback	Marleen Rosiers (EhB) Gabriel Lemkow (FUB) Marlis Henner (EB) Christian Rammel (RCE) Kristina Orban (LU) Sarah Scheer (IB) Penka Hristova (NBU) Carlo Antonini (UNIMIB) Monica Onida (UNIMIB) Milena Leneva (Tempo Foundation) Savka Savova (HESED Foundation) Anja Hopstätter (headmaster primary school Germany) Franz Janoska (Roma VHS) Mercè Requena (Catalan Government) Imma Casas (Catalan Government) Christina Siry (University of Luxembourg) Martin Scheuch (HAUP) Xavier Gironès (Catalan Government)
V1.0	13.09.2023	Revision	Irene Glockengießer (RCE) Anna-Maria Krulis (RCE) Gabriel Lemkow (FUB) Maria Lluïsa Sort García (FUB) Sarah Scheer (IB)



V2.0	26.09.2023	White Book V2	Irene Glockengießer (RCE)
		Revision	Anna-Maria Krulis (RCE) Gabriel Lemkow (FUB)
V3.0	30.09.2023	White Book V3	Irene Glockengießer (RCE)

Pending Approval

Pending Approval

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 him, existed only once among all people and that he was therefore important to the world in his own special way was. So Momo could listen!

MOMO, Michael Ende, 1974

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 piece of work. We would also like to thank all those who have inspired, challenged and strengthened us in the process of developing the White Book.

- **ANDREA NEUHAUSER**
- **MARTIN SCHEUCH**
- **FERI JANOSKA**
- **CARLO ANTONINI**
- **MONICA ONIDA**
- **MILENA LENEVA**
- **SAVKA SAVOVA**
- **ANJA HOPSTÄTTER**
- **MERCÈ REQUENA**
- **IMMA CASAS**
- **CHRISTINA SIRY**
- **XAVIER GIRON**

TABLE OF CONTENTS

GLOSSARY	11
EXECUTIVE SUMMARY & INTRODUCTION	12
RATIONALE AND CONTEXT	13
THE C4\$ HUBS	14
CONTEMPORARY CHALLENGES	16
Resources & Reform: what is needed on a structural level?	
HOW IS SCIENCE TAUGHT?	17
Didactics, Hypersimplification & Eurocentric View	
OUR UNDERSTANDING	18
Science as a Critical Community Activity!	
PROPOSED RECOMMENDATIONS	19
How this White Book works	
POLICYMAKERS	20
	
SUMMARY & INTRODUCTION	21
INSIGHTS	22
ROADMAP FOR POLICYMAKERS	24
ACTIONS AND MECHANISMS	26
QUOTES FOR CHANGE	30
LITERATURE REVIEW	31
PRACTITIONERS	32
	
SUMMARY & INTRODUCTION	33
INSIGHTS	34
ROADMAP FOR POLICYMAKERS	36
ACTIONS AND MECHANISMS	38
QUOTES FOR CHANGE	44
LITERATURE REVIEW	45
COMMUNITIES	46
	
SUMMARY & INTRODUCTION	47
INSIGHTS	48
ROADMAP FOR POLICYMAKERS	50
ACTIONS AND MECHANISMS	52
QUOTES FOR CHANGE	60
LITERATURE REVIEW	61
CALL TO ACTION	62
LETS BUILD A BRIGHTER FUTURE	
LITERATURE REVIEW & RECOMMENDATIONS	64

COMMUNITY 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 unheard by most of the population. Some examples of communities in vulnerability risk situations are 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 where 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, technologies and 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 education activities and initiatives for all communities.

INTERSECTIONALITY:

Intersectionality is a critical theory that allows to identify intersecting determinants including but not limited to gender, age, disability, education, ethnicity and more, which can contribute to inequality and marginalization. To promote inclusive science education, intersectionality is a helpful theory to reflect on issues of inequality on all levels.

PILOT ACTIVITIES:

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

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 necessity to gather data for research purposes.

RRI - RESPONSIBLE RESEARCH AND INNOVATION:

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 term, that stands for Science, Technology, Engineering, Arts and Mathematics, signifies a dynamic and interdisciplinary approach to education and problem-solving. It is frequently used when presenting or approaching these knowledge areas in an interdisciplinary manner, with activities that cross the boundaries between these disciplines by including and combining two or more of these areas.

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, institution representatives and educators, offering a diverse range of examples and recommendations at various levels to support the implementation and enhancement of inclusive science education.

The White Book is founded on the theoretical framework of inclusive science education (ISE) developed throughout the C4S project. It is based on an extensive analysis of previous initiatives, 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. Additionally, it incorporates the outcomes derived from the pilot activities carried out in eight distinct EU countries. All these activities provide 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 co-construction and co-participation process, in which the C4S project represents just one of numerous significant social actors. Consequently, this document does not aim to provide a rigid set of instructions accompanied by strict roadmaps to follow. 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, involving 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 document aims to **provide practical guidelines and orientations for promoting inclusivity in science education**. It is designed to be used by policymakers, institution representatives, educators, teachers, researchers and other relevant stakeholders. The recommendations in this White Book are organized according to the target audience, 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 Horizon2020 project „Communities for Sciences (C4S) - Towards Promoting an Inclusive Approach to Science Education,“ 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, adopting an intersectional perspective. While 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 LGBTQI 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**. While it represents a step in the right direction, **we recognize that 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 crisis, the COVID-19 pandemic and the escalating crisis of climate change and biodiversity loss.

Crises often bring about periods of instability and, unfortunately, can also foster xenophobia, aporophobia and tendencies towards uniformitarian views of societies. Vulnerable communities, including migrants, refugees, minorities, people with disabilities, women, as well as different gender identities, are particularly affected by current crises, such as pandemics, the climate crisis accompanied by the sixth mass extinction and, of course, within our society great social injustice. Facing accusations of spreading diseases, exclusion from priority health policies and misinformation campaigns, they also encounter a higher risk of school dropout. Specifically, in the case of female individuals and gender diverse persons, they experience 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, where crises have already passed but injustice 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 given that a more diverse science is also a better science, and that endorsing diversity in education both as unavoidable and as unavoidable enriching for schooling systems allows boosting 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 segregational implication 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 boost a sense of belonging within schools in all children, especially migrant children and girls we should start by reviewing the type and the quality of knowledge that is constructed in pedagogical sites. **Furthermore, the striving towards inclusion should be a never-ending process involving not only educators and pedagogical services but also policy-makers and legislators in their aim to legislate for a more fair and equitable society.**

These factors required for a more inclusive education, and as we especially focus here, for science education, necessitate an urgent reassessment of certain science education 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, institution representatives, policy-makers, children and families should be educated on these issues to address biased practices and promote more inclusive approaches. **Science can then act as a co-creator of a common and fairer society.**

THE C4S HUBS

This white book has been elaborated by means of common research on topics related to different levels of involvement from policymakers to practitioners and community members.

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.**

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 Background, 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**, where often the full range of all active social actors is not perceived. **HUBS design and implement science education activities in both formal and non-formal education settings, 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 that exist in the field of science and actively counteracting them, especially in a participatory manner. 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 role and self-reflect on institutionalized barriers that we ourselves have grown up with. Breaking through our own patterns is the 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?

In our societies, a glaring lack of integration has woven its way through the lives of countless people. Education empowers individuals and provides a means to address the emerging issues in our society. The vision of inclusive education, where every individual has access to high-quality learning experiences, resulting in greater diversity in the future, 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 erected that block the path of people from low-income backgrounds, ethnic minorities, people with disabilities and marginalized communities. These barriers perpetuate the cycle of inequality, deny equal opportunity and impede upward mobility.**

Inclusive societies strive to ensure that everyone has fair access to employment, living wages and economic opportunities. **However, the lack of inclusion deepens the gap, leading certain groups to 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, which affect every aspect of life. Marginalized groups face systemic barriers, bias and unequal treatment across various domains, including employment, housing, healthcare and justice system.

When looking at the level of policymakers, it becomes evident that the terms integration and inclusion are often used interchangeably. What needs to be clear first is their definition, and this should be internalized: **While integration means fitting into an existing group, accepting their values and culture unquestioned, 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 statement „Everyone can do something!“ is only partially correct at a structural level.

People, who would like to work but are legally prohibited due to 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 in courses. 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 background or circumstances. Representation, or rather the lack thereof, painted 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 meant that marginalized groups were severely underrepresented in positions of influence and remain so today. Their voices went 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, Hypersimplification & Eurocentric View

Science education often consists of a combination of lectures, hands-on, laboratory-based experiments, and textbook reading. 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 in the past (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 to other current approaches), with varying degrees of success, but never leading 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 range from 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 without considering other areas of science practice that may involve other skills, competencies, or approaches (from field trips to classification procedures to curatorial practices among non-experimental/non-mathematical science activities).

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 is a lack of diversity in scientific perspectives and the marginalization of contributions from scientists from underrepresented groups. Such an approach might ignore, neglect, or even cover 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 (among many others.) These include the racialization (including with negative connotations) of Roma or Black people, who are often still socially excluded, under the pretext of neuromyths that attempt to link barriers to learning with lack of cognitive ability. Or the use of degrading and often overtly sexualized and exoticized images of people from socioeconomically poor 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 inclusive science education, science educators should develop a greater awareness of past biased practices in science. 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 inclusive science education emphasizes the greatest possible diversity of voices and active participation.** Science is not just the domain of experts and specialists; this 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 come out in professional practice because discrimination occurs. Thus, diverse perspectives, experiences, and knowledge systems can be honored and integrated into scientific practices and findings. Creating opportunities for participation allows for a voice in scientific topics, methods used, and how science is used to solve real-world problems. **The view of science is often a one-sided one, precisely because science has been reserved for the stereotype of white males for hundreds of years.** 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 take targeted action.**

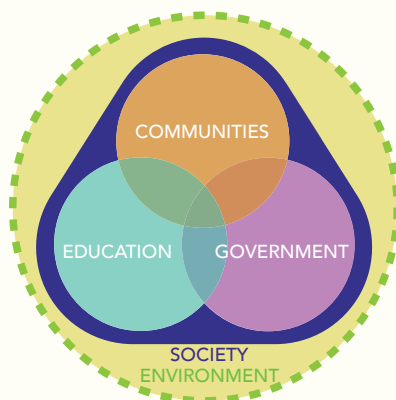
Science is often portrayed from a romanticized perspective as an individual, heroic process of discovery. **While we acknowledge the contributions of individual scientists(e.g., Einstein, Marie Curie) to science, we must nevertheless emphasize that such contributions were possible thanks to the work 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.

PROPOSED RECOMMENDATIONS

How this White Book works



In this section, we present a set of recommendations related to the promotion and implementation of inclusive science education 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 form of roadmaps including steps that need to be reflected to ensure Inclusive Science Education with and for communities. Therefore, we mention **Top Down/ Bottom-Up approaches** to show different possibilities of using the **roadmaps** in a more participatory way.

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, 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 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 education 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 education system.

In a top-down approach, changes are mandated by policymakers and implemented from the highest levels of the education system down to the local level. In this approach, policymakers and education 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 education 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
inclusive science education

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 inclusive science education 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 inclusive science education, the way policy issues are communicated and represented must change. 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 key 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. Policy makers 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 weight stronger 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, 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.

Education is a cornerstone of society, as it equips individuals with knowledge and critical thinking skills to address the complexity of the challenges ahead. To this end, it should be ensured that education is accessible to all learners, regardless of their background, skills, or identity. This chapter is a call to action for policymakers, at the international and national levels, urging them to prioritize and commit to implementing inclusive science education. 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 inclusive science education 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, but also provide teachers with appreciative and, above all, supportive working conditions. This chapter not only emphasizes the importance of inclusive science education but also tries to shed light on the intersectionality behind it.

By developing and implementing comprehensive policies that prioritize inclusivity, equity and accessibility, policymakers are laying the groundwork for transformative change. Recommendations for action already exist that provide a starting point for policy restructuring to support the implementation of inclusive science education. Challenges and considerations are not limited to only one target group, but are also relevant for other communities in vulnerable risk situations. Inclusive education 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 that ensure a sustainable, positive and inclusive learning environment. In that direction young migrants can reach their full educational potential.
- In the educational process, young migrants and their families have to be involved actively with focus on their resources e.g., social capital, children`s home language so as prior learning, competencies and qualifications that can be recognized through adequate assessments
- Further, young migrants and refugees shall be empowered to take lifelong learning activities, including vocational education and higher education. In this context, potential for digital learning and Information and Communication Technologies (ICT) should be acknowledged. Among other educational needs, digital learning and ICT are opportunities to overcome educational gaps due to, e.g., the COVID-19 pandemic.
- In the case of young migrants and refugees, holistic approaches grounded in policies, support to tackle with transition-related challenges.
- Policies that promote an inclusive learning environment are gender sensitive, reflect on the promotion of societal integration and consider human rights. These kinds of policies allow the improvement on sustainable educational outcomes without placing an unfair burden on schools, parents and communities.

TRANSFORMATION AND DESIGN

Education policy and training systems need to be reformed and rethought. We face challenges that require new ways, strategies, and rethinking. We need to cooperate and function as a society. Segregation, social gaps and the confrontation with an uncertain future do not really allow for the continuation of „tried and true“ methods. They have not proven their worth. The results in the education 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 are needed that can be implemented in a timely manner.

Recognition, consideration and active inclusion of marginalized communities are crucial, especially in the education process, with a focus on recognizing and utilizing existing resources such as social capital, mother tongue knowledge, prior education, skills and qualifications.

Young people, families, people with disabilities, migrants, refugees and other marginalized populations, regardless of their gender identity, should be actively invited to participate in the process. Enabling lifelong learning and recognizing that we are responsible for power imbalances and social barriers. To address future challenges, holistic approaches based on policies and support systems are needed. Gender sensitivity, promoting social inclusion, and addressing human rights should be integral components of inclusive education policies. Implementing such policies can improve sustainable educational outcomes without imposing unjustified burdens on schools, parents and communities.

SUSTAINABLE DEVELOPMENT

There are many goals that have been manifested in recent years to address future and survival. **We have constructed an economic system that is designed for unlimited growth on a limited area.** We live in a world of uncertainties, where ignorance is the biggest danger when it comes to the implementation of the SDG's, even if they are on everyone's lips. **We are far from reaching climate goals and social justice.**

The responsibility of persons in key positions is not only „to do a job“, but these persons must themselves be convinced advocates and supporters of an inclusive society. This responsibility is reflected in the education system, in legal and social issues, has consequences in recruitment procedures and is therefore also an aspect that is particularly relevant at the political level and must be taken into account.

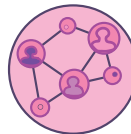
Effective measures and foundations for all of these changes and achieving the goals is not up to motivated activists. The linchpin is a legal, transparent framework that is not only determined by a privileged few, but allows the participation of all. Plural voices need to be loud and policymakers need to be open to hearing, acknowledging and valuing 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**

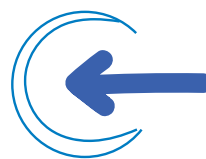
**RESEARCH
TRANSPARENT
MONITORING &
ASSESSMENT**



**BARRIER
DETECTION**



**ROUND TABLE
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 the structural levels. It should help to ensure that science education is inclusive, equitable, and accessible to all. A comprehensive education reform approach is needed that considers the multiple factors influencing student 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, particularly in science curricula and instruction. These biases and stereotypes can present barriers to learning and participation for certain groups of students, particularly those from underrepresented or marginalized communities.



DEVELOP NEW STRATEGIES - CURRICULAR ASPECTS: To move ISE initiatives forward, a thorough review and systematic revision of various science education curricula from an ISE perspective is needed. 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 disability, 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 and 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 that 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, but by 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 key to detect patterns and gaps in data to promote, boost or revise ill-fitted policies. Especially 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 co-participation and co-design of a diversity of stakeholders sensitised with these issues (or affected by them).



ROUND TABLE: To gain a better understanding of the issues at stake in promoting inclusion through active (anti-sexist, anti-racist, anti-disability, 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 inclusive science education.

ACTIONS AND MECHANISMS TO IMPLEMENT CHANGE



ROUND TABLE

The first step in creating new strategies for inclusive science education is to develop a clear and compelling vision of what inclusive science education means and why it is important. This vision should be developed in consultation with relevant stakeholders. Adjust necessary and useful policies and actions as needed based on monitoring and evaluation of progress to ensure that they are effective in achieving the goals and objectives for inclusive science education.

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

Adjust interventions as needed in feedback loops and assessment.

In order 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 panels, that are established to give a platform to challenges and barriers in inclusive science education. 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 education 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 towards the goals and targets for inclusive science education. 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.

Collect 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 co-design 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. Enforce a transparent monitoring and evaluation measure in support of these initiatives that enforces that EU governance teams responsible for evaluating and tracking science education initiatives (funding initiatives, science education 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 inclusive science education, 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 that limit the full participation of certain student groups, such as power dynamics, marginalization, and privilege in science research, be addressed. A pluralistic workforce, in which children and families have the opportunity to consider issues from multiple perspectives, should also avoid or expose barriers to particular communities or social groups. Policies do not always facilitate the implementation of such a diverse workforce. 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, which can lead to prejudice and stereotyping or render entire social groups invisible (scholars who are experts in and members of communities in risk situations). Use intersectional pedagogical teams 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, with some of 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 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 disability, as well as members of at-risk communities.



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

One of the key factors in implementing high-quality standards in European education systems is the provision of resources to support regular training at the institutional and policy levels, 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, which 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, 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 for more inclusive and culturally responsive science education initiatives to be offered.



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. Fund teacher training, technology, textbooks, and other resources necessary for effective teaching and learning. Adequate resources help ensure that all students have equal access to a high-quality science education. Also consider establishing a new EU flagship program for ISE initiatives:

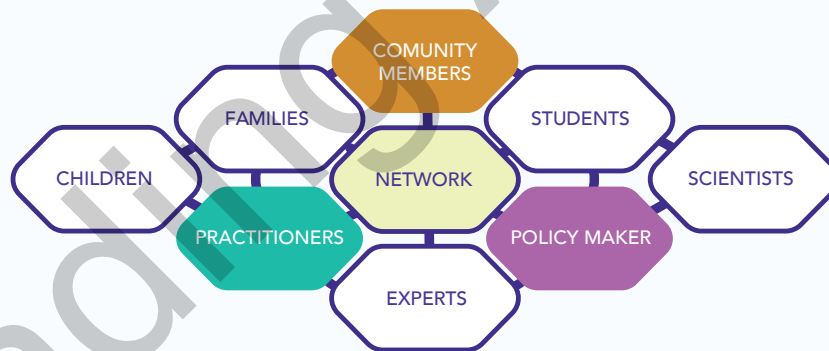
Promoting inclusive activities and spaces and opening opportunities for change toward anti-sexist, anti-racist, and anti-AIDS initiatives (among others) can be facilitated through the creation of new flagship programs that address these issues. **Developing such programs to provide funding and data for 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, modelled on the Open Science, Open Voices, Open Barriers cloud initiative, where 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 inclusive science education. 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 inclusive science education. 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 policy makers CAN bring about change.

Governance should involve a wide 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 inclusive goals marked, to reach the target participants in inclusive science education initiatives and develop a comprehensive implementation plan in consultation with relevant stakeholders.

Addressing and supporting inclusive science education issues at the policy level includes acting on accessibility and environmental justice to provide children, regardless of their socioeconomic or biographical situation, with equal opportunities to receive quality science equipment, as well as access to green spaces where they can learn and discover science phenomena. In line with Leader's 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 EXPERIENCE & 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 benefitting 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)



ON INCLUSIVE EDUCATION:

“An ongoing process aimed at offering quality education for all while respecting diversity and the different needs and abilities, characteristics and learning expectations of the students and communities, eliminating all forms of discrimination” (UNESCO, 2009, p.113).

>> 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.p



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 of Inclusive Science 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 addressed to
Teachers, Trainers, Educators,
Multipliers

IMPORTANCE OF INCLUSIVE SCIENCE EDUCATION

TRAINING AS THE KEY TO INCLUSION AND MINDFULNESS IN EDUCATION SYSTEMS

Inclusive science education in early childhood is important to support and develop a child's natural curiosity and fosters the love of learning. It helps to promote diversity and equity in the fields of science, technology, engineering, arts and mathematics (STEAM) by providing all children with the opportunity to learn and engage with science, regardless of their background or abilities.

Inclusive science education is the key to close 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 that are needed for a transformation in educational systems.

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

Education is one of the main foundations of a prosperous society, shaping new generations that will create our future. However, these generations are raised in an educational system facing a multitude of challenges at multiple levels and whose consequences are severe.

This chapter for practitioners highlights long-known, as well as emerging, challenges ranging from burnout, to staffing shortages, to teacher training, and the overall impact on the education system.

AFTERMATH - THE RIPPLE EFFECT

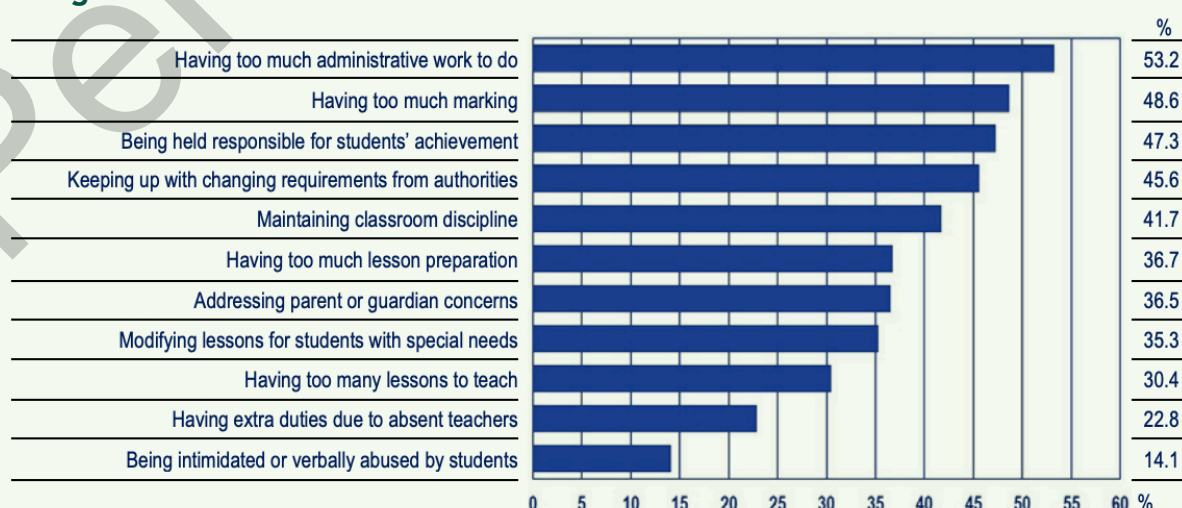
Social institutions in general, but here we turn to educational institutions, are already struggling with a critical shortage of staff, teachers and support personnel. This condition will become even more drastic in the coming years. Factors such as low salaries, limited benefits, and increased responsibilities no longer paint an appealing picture of the teaching profession. As a result, **schools are struggling to find and retain qualified professionals, leading to larger class sizes, poorer student support services and a diminished learning experience for students, in a system that is already outdated and out of touch with time. Staffing shortage directly impacts 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 and works. These schools are unique, but unfortunately they are not a standard to follow. It is questionable why, but numerous studies show that there are models 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, and 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.

Even though it affects people in the existing education system, the consequences just mentioned go far beyond personal well-being, as burned-out educators may not be able to provide the best education possible to their students. Studies on the knowledge levels of children and youth often speak volumes, especially after years of closure. In addition, not only are there massive gaps in knowledge, but 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://euridice.eacea.ec.europa.eu/sites/default/files/teachers_in_europe_2020_chapter_6.pdf

PROMOTION FOR A BRIGHTER FUTURE

The teaching profession is a wonderful job: you get to support children and young people to grow up, accompany them as they build up the knowledge they need to shape their own lives, and be there for them when problems arise. The training must therefore be of a high quality, preparing you for a great but very demanding profession. As mentioned earlier, there is already a shortage of teachers across Europe. This could only be a temporary problem if it were foreseeable that there would soon be graduates from teacher training colleges to fill these vacancies.

But here, too, there has not been the same influx and graduation rate 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 on the part of politics and society. 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. One needs commitment and love for people, which is quite often put to the test in the course of a teacher's life. This profession does not bring with it prestige in most cases. However, practitioners deserve recognition in their role as advisors, facilitators, initiators and organizers.

One goal to counteract problems with staff shortage must be to give more recognition to the work and contribution 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. The multiple burdens of long hours and constant pressure to meet academic expectations, demanding situations in daily school operations, as well as unexpected aggravations such as the pandemic and its aftermath puts a strain on their mental and physical well-being.

IT'S ALL ABOUT THE TOOLS

ISE is only possible if there is personnel with the capacity to respond to individual situations, people and needs. Possibilities thrive if there are resources, 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 liveable future and supports educators to accompany students on their individual learning journey.

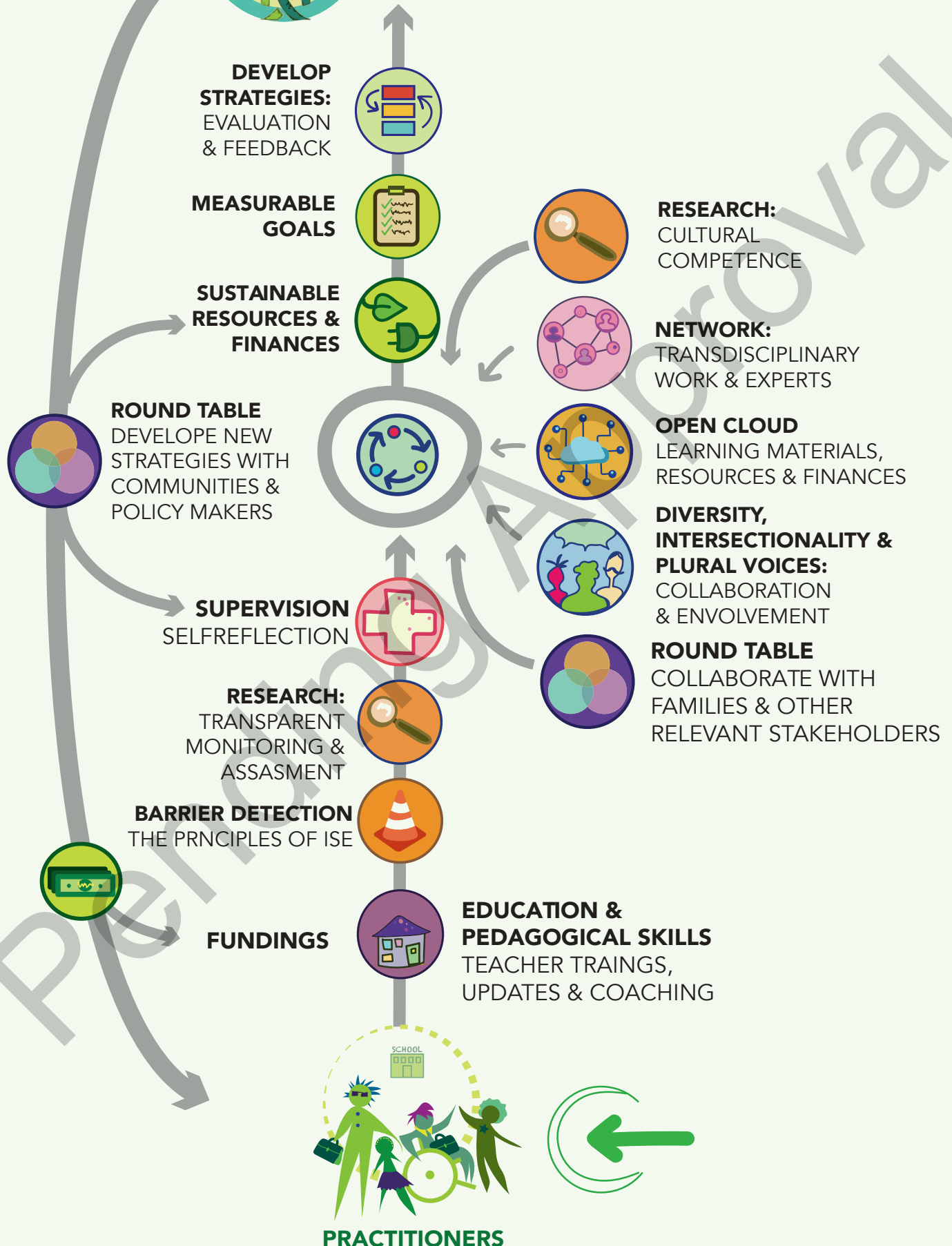
The overcoming of all those challenges requires comprehensive strategies of different stakeholders on a structural as well as on an individual level.

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 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 education activities, by listening to the voices of educators from the local communities, by boosting new pedagogical strategies promoting the 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, it is also essential to act de facto 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



ROADMAP FOR PRACTITIONERS

The Roadmap for Practitioners is not only for teachers, it is addressed to multipliers, educators, trainers, but also coaches. It might be a helpful guideline to develop and grow as a mindful expert 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 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 to create inclusive learning environments and address individual student needs. Regular evaluation and feedback mechanisms should be in place to check improvements.



DIVERSITY, INTERSECTIONALITY & PLURAL VOICES: COLLABORATION & INVOLVEMENT: Working together creating science education programs and opportunities for the needs and interests of all students is a process that should be done with a diverse workforce. Inclusive education should involve 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 background or abilities. Training programs should offer hands-on practice opportunities and allow participants to apply 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 inclusive science education. Policymakers need to ensure adequate funding to provide equal opportunities for all students, regardless of their socioeconomic background.



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, adapted to the specific contexts of the participants. This approach ensures that educators are well-prepared to create an inclusive environment and diversity.



ROUND TABLE: Roundtables under the practitioners' chapter are needed to provide collaborative platforms where educators, policymakers, experts, rolemodels and community members come together to discuss, share experiences and develop strategies to solve complex challenges related to inclusive science education. 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 AND PROFESSIONAL DEVELOPMENT: Stay up to date with the latest research and best practices in inclusive science education. It is important to be a lifelong learner and to seek out professional development opportunities. The training should include opportunities for participants to continue their learning and professional development after the training is over. Mentoring and coaching: The training should include mentoring and coaching support, which can help the participants to apply learning to their own contexts and 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.

ACTIONS AND MECHANISMS TO IMPLEMENT CHANGE



EDUCATION & PEDAGOGICAL SKILLS, & ISE-TRAININGS

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

Value diversity, promote understanding and respect

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

Given that certain 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 co-creating and participating in STEAM initiatives requires knowledge of communication, human sensitivity, 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, respect and acceptance about the impact of culture on learning. Pedagogical skills are essential for designing and delivering 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 begins with identifying areas of lack of inclusion and diversity through a needs assessment involving students, teachers and stakeholders. This assessment includes 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 reveals very effectively disparities between student groups and areas where barriers may exist.

Identify Barriers: Conduct a thorough assessment to identify barriers to inclusion and diversity within the educational setting. Examine physical, economic, and cultural factors that may impede access to inclusive education. Analyze student achievement, enrollment, and graduation data to identify disparities and potential barriers. Reflect on personal biases and stereotypes that may affect instructional practices.

Engage Stakeholders: Collaborate 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. Establish partnerships with community organizations. Foster a sense of belonging and inclusion among students by valuing their cultural backgrounds and identities.

Adapt Instructional Practices: Attend professional 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.



Promote Equity and Access: Advocate for the removal of barriers to science education, such as limited resources or financial constraints. Facilitate early exposure to science education for underrepresented students. Offer mentorship programs and opportunities for hands-on learning 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.



Continuous Improvement: Regularly evaluate and reflect on instructional practices to ensure inclusivity and effectiveness. Stay updated on research and best practices in inclusive science education. Seek opportunities for professional growth and learning to enhance teaching strategies. Advocate for policy changes and resources that support inclusive science education.

By applying these checkpoint strategies, educators can actively contribute to the implementation of inclusive science education 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 key, to stay informed about the latest research and best practices in inclusive science education. For co-participatory local STEAM research, establish:

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, has the potential to inform inclusive and impactful education initiatives that align with community needs and aspirations. This could be achieved through collaborative action research with families and special consideration given to the neighborhood. This research should focus on understanding the history and culture of the local community and establishing connections between community 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 color-blindness or gender-blindness biases.

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. Engaging a variety of voices, including families and people who can tell successful stories related to STEAM activities or initiatives, but 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 serve as inspiration for students. Children and youth 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 expertise 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 AND PROFESSIONAL DEVELOPMENT

As a multiplier committed to inclusive science education, it is important to prioritize resilience in the face of challenges. Through building a support network of like-minded educators, continuously learning about best practices in inclusive science education, and reflecting on one's own teaching practice areas for improvement should be identified.

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 education setting for all students.

Observation is needed, with the supervisor observing the educator's teaching practice 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 help to create a plan for achieving those goals. Feedback should be given on a regular basis to adapt strategies.

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

Unfortunately, there is often a suboptimal work/life balance in social work professions. 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 in order 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 practice. 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 inclusive science education, 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, resilience is therefore a goal that needs to be achieved. 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, where 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. By doing so, you help creating a diverse and inclusive learning environment where everyone can see themselves and their experiences reflected in the books they read. To work with role models from different backgrounds, including those with an intersectional gender perspective is another way to Diversity. Seek out individuals who can serve as positive examples for children and families, that break down stereotypes and promote 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 STEM 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, in which subjects from different communities were represented.

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 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 where a change in funding and providing resources from policy makers would be necessary and helpful.

ROOM FOR MORE IDEAS:



STRATEGIES, EVALUATION & FEEDBACK:

„Top-down“ and „bottom-up“ are two approaches to decision-making and problem-solving that differ in their focus and methodology. Both, top-down and bottom-up 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 should be aware of those two approaches and informed about their crucial role as co-researchers. Effective practitioners are adaptable, responsive, and able to navigate between different approaches, in order 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**.

There 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** where families can contribute materials related to everyday science and STEAM knowledge, which are periodically curated.
- ✓ **Hold a meeting with families** to clearly define the content of an information leaflet for families.
- ✓ **Organize a co-participatory 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 have regarding participation and accessibility.
- ✓ **Gather common topics** suggested by workshop participants and form co-working teams to address different areas such as welcoming spaces, playgrounds, communication departments, websites, and mother's empowerment workshops, ensuring diverse representation in each team.
- ✓ **Conduct field action-research** in collaboration with families and community members: identifying needs, proposing solutions, prototyping, voting for the best prototypes, implementing changes, evaluating the outcomes, modifying original proposals, and sharing 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 to create a more inclusive and equitable learning environment.

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 background, 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, we need defined, realistic goals. Similar to a living organism, education thrives on synergies, linkages, and dynamic relationships that influence each other. **Barriers often arise or only become visible during a process. 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 **and show 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 **inclusive science education**.
- **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.
- **Numbers 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.
- **Science 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



EXPERT 1 BRUSSELS HUB

“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.”

Expert interview, November 25th, 2022



TEACHER 1 BRUSSELS HUB

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

Pilot teacher, June 2022



TEACHER 2 BRUSSELS HUB

“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, 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 (2022). C OMMUNITIES 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.org/10.1111/cch.12621>] <https://doi.org/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 addressed to
Community members, Stakeholders,
Museums, Institutions

COMMUNITIES IN EVERYDAY LIFE – LISTEN TO TARGET GROUP VOICES

To improve access to inclusive science education, we need to focus on the needs and perspectives of target 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 that recognizes, values and respects their cultural identities and experiences. Incorporating culturally relevant content into the curriculum and utilizing 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 education 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 involvement in decision-making processes recognizes community expertise as such, reflects life experiences, and supports equity and justice. Communities don't 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 policy makers 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, as it is highlighted in the chapter for policymakers. Concerning Practitioners, it is often simply individual steps and twists that can already make a big difference.**

It is absolutely necessary for policymakers, whether at the local, regional, or national level, to make basic provisions by implementing policies, allocating resources, and establishing support systems, thus generating a solid inclusive foundation. By prioritizing funding for community-based science education programs, taking action to promote inclusion, or working directly with community organizations, actions automatically lead to improved educational opportunities for marginalized groups, 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. Probably every individual has had experiences of discrimination, incomprehension or injustice in one way or another. But what is crucial is whether these also occur at a structural level and an everyday basis.** Addressing these issues requires a comprehensive approach that includes legal protections, education and awareness campaigns, policy reform, community engagement, and the promotion of inclusive and equitable practices in all sectors of society. Discrimination prevents the very access to educational, employment and economic opportunities for individuals or 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: increasing 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 POWERTOOL

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, while 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 disadvantage, but it can be problematic for several reasons: There is certainly a tendency to lump people with different identities, experiences, and needs under a single term and ignore their unique characteristics and circumstances. The use of the term „vulnerable groups“ can lead to homogenization and simplification of different communities. In our work and 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 disempower marginalized communities.

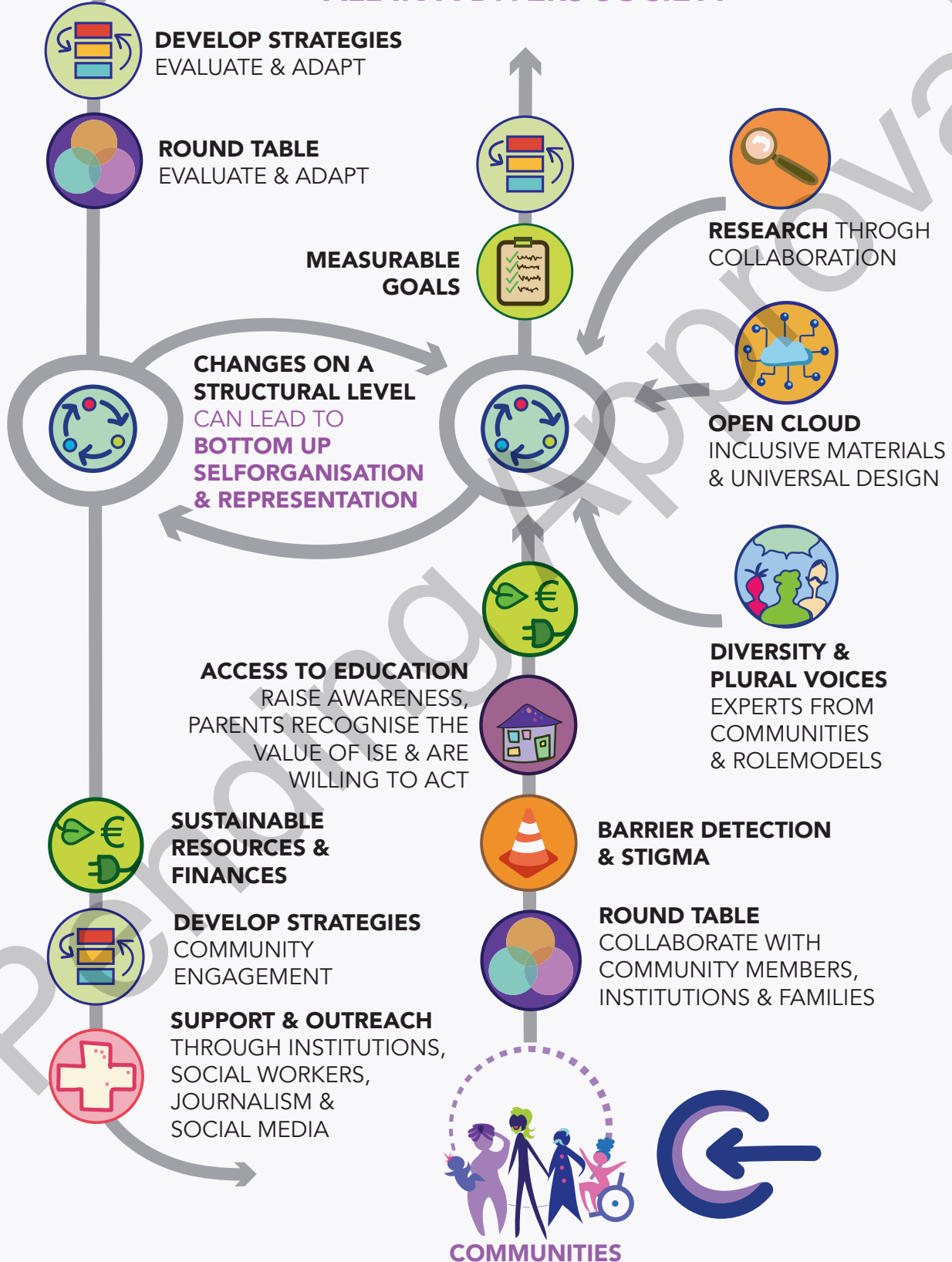
It is a fact that people have multiple identities at the same time, which intersect and shape their weaknesses and strengths. Using a single term hides these nuances. Thus, instead of using the term „vulnerable groups,“ a simple solution approach would already be, to take a more nuanced and inclusive 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 daily life, creating problems and challenges on multiple levels. It requires recognizing and addressing specific challenges and barriers due to different identities, circumstances, and experiences. Empowerment, resilience, and strengths-based perspectives should be promoted rather than focusing solely on vulnerabilities.

ROOM FOR MORE IDEAS:



EQUAL OPPORTUNITIES FOR ALL IN A DIVERS SOCIETY



ROADMAP FOR COMMUNITIES

This map shows a complex path to creating awareness of and access to inclusive science education for target audiences and members of diverse communities. The work of C4S has demonstrated and 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 was useful and often one is trapped in one's own bubble. We explain the most important icons in detail.

-  **BARRIER DETECTION & STIGMA:** Access to science education for underserved and marginalized communities means working to reduce financial barriers to science education and promoting greater accessibility of science education programs for students with disabilities on a structural level, for example. ISE necessitates the identification and elimination of stigma. Policymakers must prioritize dismantling societal misconceptions and biases.
-  **DEVELOP STRATEGIES & COMMUNITY ENGAGEMENT:** Encouraging communities, parents and families to participate in science education programs, promoting science education as a means of addressing social issues and challenges, and creating 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 inclusive science education 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: MATERIAL, SUSTAINABLE RESOURCES & FUNDING:** Suitable tools, toys and learning materials for inclusive science education need 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, particularly in preventing harm or hazards, especially with younger learners or persons with disabilities.
-  **MEASURABLE GOALS: DATA & IMPACT:** Collecting and analyzing data on student outcomes and experiences in science education programs, evaluating the effectiveness of ISE practices, promote greater inclusivity and equity in science education. Help revise gaps in the metrics and in the promotion of more transparency in the use of data
-  **RESEARCH THROUGH COLLABORATION:** Engage with science education providers, such as schools, museums, and science centers, to promote inclusive science education, to develop inclusive curricula and learning materials, by providing feedback on the accessibility and inclusivity of science education programs.
-  **ROUND TABLE:** A roundtable brings together policymakers, practitioners, scientists and communities is 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 towards 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 in danger of mobbing, 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 inclusive science education 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 much more encompasses **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 background or circumstances, can meaningfully participate in science learning but also to actively identify and break through barriers to solutions.

Raising awareness means first of all 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 decolonial critical perspective. **Plural voices need to be heard in freely chosen spaces where people have the choice to accept educational offers.** This requires first of all safe spaces for families and their common bonds. Numerous round tables are key for brainstorming, concepts and strategies.

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 hindered or denied equal access to quality science education already 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 multi-layered and interconnected nature of individuals' experiences. More so, it is necessary to be aware of this complexity to change social constructs as well as individuals' prejudices. **The intersectional 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. 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 working to dismantle the systems of power and privilege that perpetuate inequality and discrimination.

The key to acknowledging and emphasizing diversity starts with something as simple as communication. Language creates realities, but it is one of the easiest ways to implement diversity and this means in the same way support and empowerment.



RESEARCH & COLLABORATION:

It is very important to keep target 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 they wish to participate.

The empirical research must be calibrated based on the target group, considering for example the age of the children and their socio-economic background, the location of the educational centre, the specific educational proposals. It 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: greater confidence of families with educational institutions, improve family-teacher dialogue and fosters curiosity.

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



ROUND TABLE

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

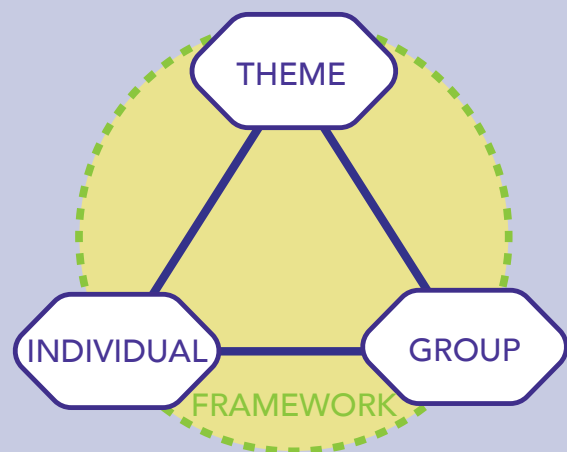
The round table methodology may prove useful for this purpose, to share expert advice and for having conversations about opposing viewpoints on the same topic. It can be a tool either to involve a limited number of participants, allowing them to actively discuss and can act as a collector of needs, opinions, ideas. Or it can involve many people: in this case, the round table has more value in disseminating strategies and proposals. It is possible to organize virtual roundtable discussions. It is important to tailor the experience to the background of the audience and book 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“.

TCI 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, as the balanced participation of the individual, 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 multi-faceted approach. Here are some useful strategies /enablers:

Early 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 like 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 education systems.

Creating a safe and supportive learning environment where all students feel respected and valued promotes engagement and success. Collaborate with practitioners.

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 inclusive science education 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 education 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 inclusive science education. Dialogue and co-creation 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



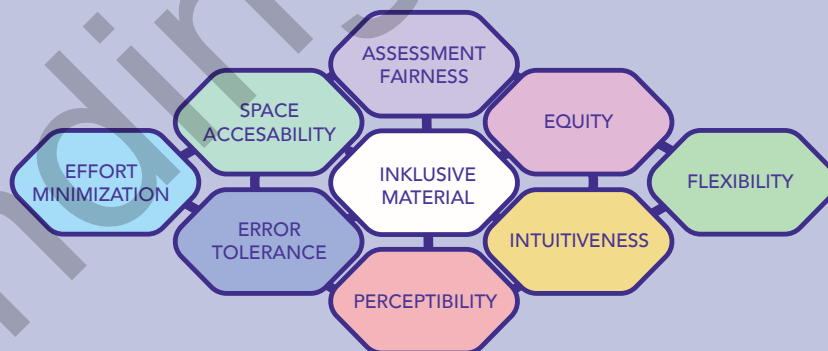
Tools and toys must first be suitable for the target group of users, bearing in mind their age and any manual, visual or hearing difficulties. **The safety of the tools must be absolute**, even considering possible improper handling (e.g., no small parts should be used with pre-school children).

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 to care about the environment.
- ✓ **Avoid Non-Recyclable Materials:** Refrain from using plastic or non-recyclable 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 as pots, funnels, or ladles, to facilitate repeated activities at home to promote 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 where all students can actively participate, learn and succeed.

UNIVERSAL DESIGN - INSTRUMENTS OF CHOICE



Universal Design designs 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 as 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 advancement, 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 vulnerable 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 charting the path of transformation toward meaningful change. In this context, as already mentioned in the Policy-maker level, a simple basic strategy can be followed, which 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.

CHECKLIST TO INCLUSION

We have compiled a step-by-step guide based on our experience that can be easily adapted and, in the best case, 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 towards 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 in and with challenging situations, it can happen that there are emotional depths that can also have a massive impact on your own mental health. This is where support needs to be expanded and can be directly supported by policymakers and targeted funding by providing fast help without great administrative effort or long waiting times.

SHOUT OUT LOUD

In a plural and diverse society, equal opportunities for all is essential to avoid discrimination, exclusion and segregation. Equity should play a central role also in the 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 education activities, by listening to the voices of educators from the local communities, by boosting new pedagogical strategies promoting the 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, it is also essential to act de facto at an institutional practical level to boost equity and pluralism in the working 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:

Pending Approval

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 and 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

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 (CEE/CIS).
- 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

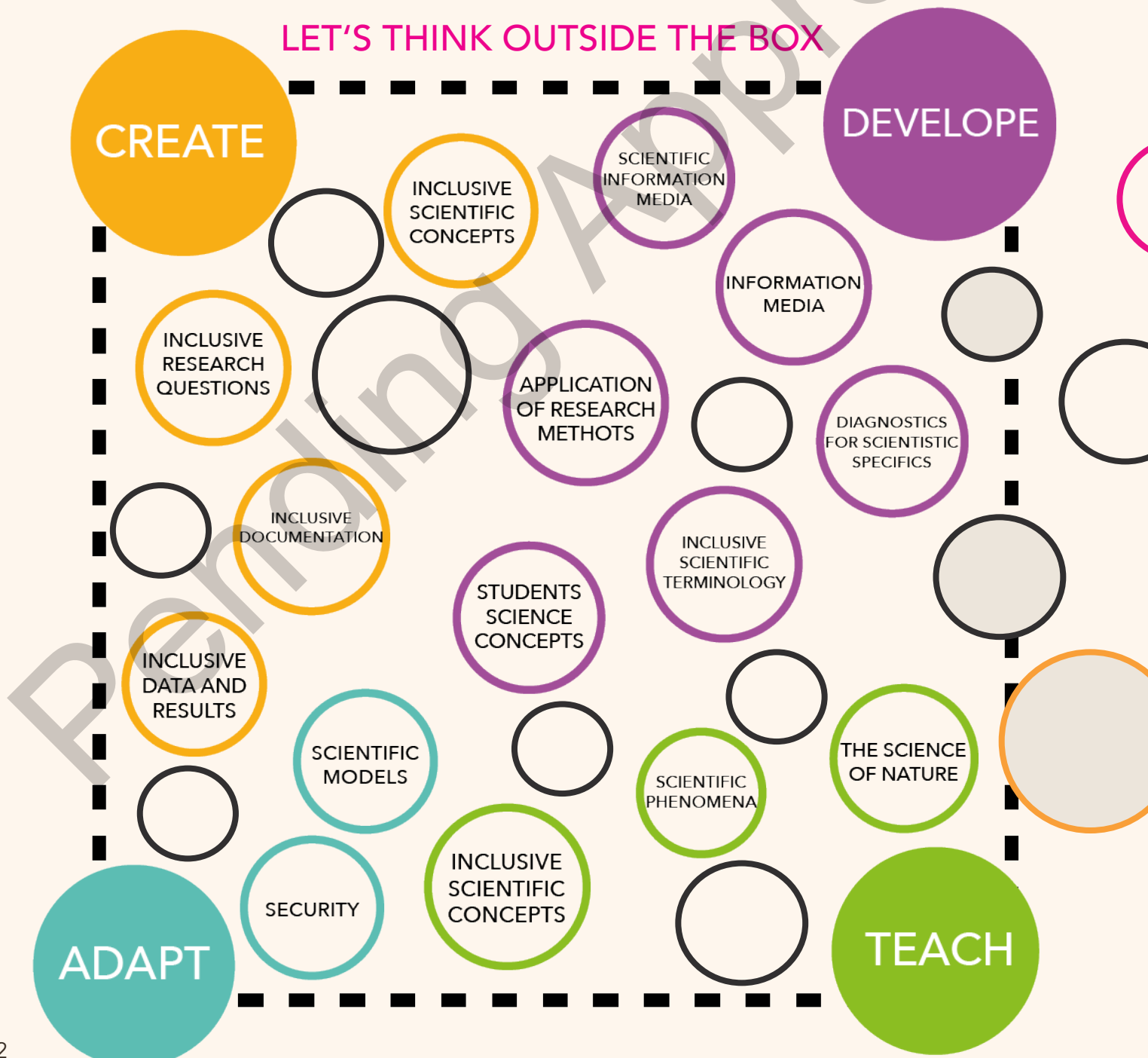
LET'S BUILD A BRIGHTER FUTURE


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

We have to remember that our journey towards 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 where 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?

LET'S THINK OUTSIDE THE BOX





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 inclusive science education 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 learnings and embrace innovative teaching methods that cater to diverse learning needs. Let's work on classrooms where 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 education initiatives, 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.

LITERATURE REVIEW & RECOMMENDATIONS

- 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*. 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-ae9-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](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 Comission (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](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](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 Committee (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., Bécaries, 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=3C2C52DE55E915B0FC394A05400ACFFB#:~:text=The%20strategy%20for%202019%20%E2%80%932022,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 COVID-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/10.1080/01418870.2017.1361544>

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=IDDRnCV2frzibw-JG4X_wfKtPds