

EDUCATION FOR DEMOCRATIC CITIZENSHIP: THEORY AND TEACHING PRACTICE

Session 7: Implementing Education for Democratic Citizenship and Human Rights Education (EDC/HRE) in STEM Education

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Equity should be prioritized as a central component in all educational improvement efforts. All students can and should learn complex science. However, achieving equity and social justice in STEM education is an ongoing challenge. Students from non-dominant communities often face “opportunity gaps” in their educational experience.

As the world becomes more inter-connected and competitive and as research and technological know-how expands, new opportunities along with more complex societal challenges arise. Overcoming these challenges will require all citizens to have a better understanding of science and technology if they are to participate actively and responsibly in science-informed decision-making and knowledge-based innovation. It will involve input from user groups, specialists and stakeholder groups. Professionals, enterprise and industry have an important role to play. In this way, everybody learns and benefits from the involvement.

Inclusive approaches to STEM education can reposition youth as meaningful participants in science learning and recognize their science-related assets and those of their communities.



Teachers should work with colleagues to implement instructional strategies to make STEM learning experiences more inclusive for all students. Policy makers should integrate a focus on equity and social justice into every teacher learning experience in relevant ways—and not treat diversity as a segregated topic. School leaders should promote a sustained focus on inclusive science instruction. Efforts should be made to resource and monitor equitable opportunities to learn science.

STEM education research, innovation and practices must become more responsive to the needs and ambitions of society and reflect its values. They should reflect the science that citizens and society need and support people of all ages and talents in developing positive attitudes to science. We must find better ways to nurture the curiosity and cognitive resources of children. We need to enhance the educational process to better equip future researchers and other actors with the necessary knowledge, motivation and sense of societal responsibility to participate actively in the innovation process.

Democratic societies require an engaged and responsible citizenry contributing at all levels of society, across Europe and the world. STEM education is vital:

- To promote a culture of scientific thinking and inspire citizens to use evidence-based reasoning for decision making;
- To ensure citizens have the confidence, knowledge and skills to participate actively in an increasingly complex scientific and technological world;

- To develop the competencies for problem- solving and innovation, as well as analytical and critical thinking that are necessary to empower citizens to lead personally fulfilling, socially responsible and professionally-engaged lives;
- To inspire children and students of all ages and talents to aspire to careers in science and other occupations and professions that underpin our knowledge and innovation-intensive societies and economies, in which they can be creative and accomplished.

Teaching equity in STEM

Equity in education means removing barriers so that all students can reach their academic potential. As we work toward more inclusive classrooms, we must specifically target subject areas in which students with marginalized identities have traditionally experienced an opportunity gap. At the top of that list is the subject of STEM education. Some ways to start the important work of promoting equity in STEM education are presented below:

1. STEM is typically framed as a Western concept that emphasizes the accomplishments of white men. The reality is that people all over the world have made significant contributions to scientific advancement. If your textbook credits Copernicus with the theory of planetary motion, bring up that Arab astronomers, were actually the basis for this model.



2. Display a poster of women scientists. Teach a lesson about a famous scientist with a disability, like Stephen Hawking. The more diversity your students see, the more likely they are to believe that the study of science is for them, too.
3. We tend to view children’s talk as disruptive, but in a STEM classroom environment, it’s an essential tool for making sense of new ideas. When students are free to communicate using unofficial talk and encouraged to use their home languages, they engage more frequently and can even arrive at deeper understandings. For example, a native Spanish-speaking child studying volcanoes may note that a mountain is *dormida*. To think of a mountain as a sleeping volcano is useful and helps them further understand the English word *dormant*.
4. We tend to teach the scientific method as canon. Really, there is no single approach to science but rather a broad spectrum of practices. Engage students in the “doing” of science—whether that’s making a model of the water cycle or observing and recording the behavior of a class pet. To go along with this rethinking, you must also accept out of the box answers. Encouraging a diversity of perspectives allows for more rigorous solutions and sophisticated learning.
5. Students need to be able to relate to the content. Try and put it in a context they can understand. If you’re studying fungi, discuss how yeast is required to make dough rise. This helps students make connections between home (in this case, baking) and school (here, biology). They begin to see science less as a foreign practice and more as a way to relate to and understand the world around them.



6. Talk to students and find out about needs and issues in their own communities. Is there a need for a neighbourhood garden? Gardening provides a wealth of opportunities for STEM learning. For example, students can learn about photosynthesis or apply chemistry knowledge to test the pH of soil. Addressing a real-world problem that affects them is highly motivating for students and shows you care about them and where they come from.

STEM and citizenship

The world is changing so fast that citizens need a deeper understanding of global societal challenges and their implications for themselves, their families and their communities. This requires a broader vision of an active, engaged and responsible citizenship for the 21st century.

To be successful, we require a collective vision and shared sense of accountability responsibility and innovation by all society's stakeholders. This includes schools plus further and higher educational institutions, families, teachers and students, enterprise and business and public and civil society organisations. It involves all members of the European Union, at local, regional, national and EU level, acting together in a coherent and integrated way.

Given the multi-faceted nature of the objectives and recommendations, it is strongly recommended that the different educational systems bring together key actors from within their



countries to initiate a participatory consultation and dialogue process across the EU and proposed actions and how they should be implemented. The different countries should use the suggestions to build synergies and co-operation across portfolios in order to lead to tangible results.

Collaboration and networking between the different communities across the EU can provide important opportunities to enrich the lives of European citizens. Finally, the different countries should also implement a comprehensive dissemination programme. In the spirit of engaging citizens in the understanding and about science, the dissemination programme should include a combination of workshops, leaflets, comic book formats, video, film, community theatre etc. An accompanying public communications strategy should be developed in order to reinforce a consistent message.

An objective could be STEM education should be an essential component of a learning continuum for all, from pre-school to active engaged citizenship. In order to achieve this objective education policies and systems should:

- Ensure that STEM education is an essential component of compulsory education for all students;
- Support schools, teachers, teacher educators and students of all ages to adopt an inquiry approach to STEM education as part of the core framework of science education for all;
- Address socio-economic, gender and cultural inequalities in order to widen access and provide everyone with the opportunities to pursue excellence in learning and learning outcomes;
- Create mechanisms to foster individual reflection and empowerment.

- STEM education should balance requirements of breadth and depth of knowledge about science to ensure young people and adult learners are both motivated for learning and equipped to fully engage in scientific discussions and decisions and to facilitate further and deeper study.

Some indicative actions for promoting citizenship through STEM education could be the following:

1. Develop Guidelines for Systemic Change to underpin STEM Education for Responsible Citizenship initiatives and their evaluation;
2. Initiate actions which strengthen links and cooperation between formal, non-formal and informal STEM education;
3. Introduce actions to promote gender sensitive practices and innovations in STEM learning;
4. Introduce actions to address socio-economic and cultural inequalities to ensure access to STEM education, with an emphasis on rural, isolated and disadvantaged communities;
5. Support the expansion of ICT to widen access and participation in STEM education, for all talents, in and beyond the classroom.

6. Develop educational pathways for scientific and technical employees and unemployed workers especially young people, to access scientific and technical qualifications.
7. Provide student-centred STEM education programmes which recognise and are sensitive to different learning methods.

Conclusions

Success in the 21st century depends upon acquiring key competences rather than simply learning facts. Being able to collaborate, listen to the ideas of others, think critically, be creative and take initiative, solve problems and assess risk and take decisions and constructively manage emotions are interdependent. They are considered essential for success in adult life and the basis for further lifelong learning. They also contribute to active citizenship at local, national, European and global level.

Innovative new ideas and creative solutions often emerge at the margins of disciplines. New ways of thinking do not only come through pure, applied or commercial research or technological change but also because of changes in the way in which we do things. Social innovation takes place in daily life, in social relationships and in the home and may be focused on new services and new ways of organizing society, work and ourselves Making connections between STEM and all other disciplines – what is often referred to as STEAM – pushes beyond the boundaries of science to embrace the creative potential of linking the arts, scientific inquiry and innovation Innovative new ideas and creative solutions often emerge at the interface between

disciplines and involve different societal actors. Innovation is linked, directly or indirectly, to human experience, needs and problems. This can occur through engaging with the arts – playing or listening to music, dancing, experiencing or creating art, watching and creating video or film, or being involved in designing and making.

Linking the arts and humanities with science, technology, engineering and mathematics brings the scientist, engineer, entrepreneur, artist and designer into dialogue to offer the widest range of opportunity and academic and societal insight for experimentation and innovation. Involving the social sciences helps us understand what works, what doesn't work and how to improve the quality of life for everyone.

