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for Education

TOOL

16

Mainstreaming gender equality in science, technology, engineering and mathematics education



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Table of Contents

Objectives	1
Key information: Setting the scene	1
Key considerations	2
Self-study and/or group activity	4
Improving girls' and women's inclusion in STEM subjects	5
Box 1: Linking schools with science research	6
Further reading	7
References	8



Objectives

The objectives of this tool are to:

- raise awareness of the barriers to inclusion faced by girls and women in studying science, technology, engineering and mathematics (STEM) subjects and/or engaging in STEM careers;
- provide suggestions for changes that are needed to ensure more girls and women engage in STEM studies and careers.

Key information



Setting the scene

“Only 20 women have won a Nobel Prize in physics, chemistry or medicine since Marie Curie in 1903, compared to 572 men.”¹

Today, only 28% of all of the world’s researchers are women.

Such huge disparities, such deep inequality, do not happen by chance.

Too many girls are held back by discrimination, biases, social norms and expectations that influence the quality of education they receive and the subjects they study.”²

In many countries, in the Asia-Pacific region and globally, girls and women face limited opportunities regarding the educational pathways open to them. Social and cultural expectations may encourage boys and girls to pursue gender stereotyped areas of study. Consequently, girls and women are significantly under-represented as students within science, technology, engineering and mathematics (STEM). They become less likely to study STEM subjects in higher levels of education, but even in the early years of education, gender divisions are evident in terms

of the subjects students appear to prefer or are encouraged to focus on.

There is no biological or genetic reason why boys appear to prefer and/or perform better in STEM subjects. Instead, evidence suggests that social, cultural and gender norms influence the way girls and boys learn; how and what they are encouraged to learn, or feel they should learn. Girls are often said to ‘self-select’ non-STEM subjects, but “this ‘choice’ is an outcome of the socialization process and stereotypes that are both explicitly and implicitly passed on to girls from a young age”.³

STEM subjects are increasingly important in the modern world. Educating girls and boys effectively in these subjects will be crucial for the fulfilment of the 2030 Agenda for Sustainable Development, not least because of the role of STEM expertise in tackling climate change, improving health care and food security, and so on. In addition, gender inequality in subjects of study is inevitably matched by a lack of women in STEM-related careers, which in part contributes to the continued inequality in employment and income opportunities.

1 Nobel Prize awarded women. NobelPrize.org. Nobel Media AB 2019. Sat. 21 Sep 2019. <https://www.nobelprize.org/prizes/lists/nobel-prize-awarded-women/>.

2 UNESCO. 2017. *Cracking the code: Girls' and women's education in science, technology, engineering and mathematics (STEM)*, Paris: UNESCO.

3 Ibid. p.12.

Key considerations

There are many reasons why girls and women may feel discouraged from or unable to engage in STEM subjects in school or STEM careers after school, including:

Sex of the teacher	<ul style="list-style-type: none"> • In many contexts there are far fewer women than men teaching STEM subjects. • Where all or most STEM subject teachers are men, girls may feel there is no role model for them in these areas of learning. • Girls, especially adolescent girls, may feel uncomfortable about being taught by men. In secondary education in particular, there are often more male than female teachers. Girls may choose non-STEM subjects in order to have at least some female teachers.
Teachers' attitudes and practices	<ul style="list-style-type: none"> • In some contexts, such as rural areas, there is a shortage of STEM-specialist teachers generally. This affects the quality of teaching, which in turn can discourage learners from studying these subjects, especially learners who feel less confident in the subjects (often girls). • Teachers' behaviour in class influences learning and motivation. Teachers may have lower expectations of girls in STEM subjects. They may be biased towards supporting or listening to boys in these subjects, or encouraging boys to take leadership roles when girls and boys are learning in groups. • Teachers may fail to differentiate their teaching. This is a problem not just in terms of their lack of flexible responses to learners with different learning needs, but because it may be failing to respond to girls' and boys' different learning style preferences. • Teachers may express gender stereotyped views about the subjects they think girls and boys should study at higher levels or the careers they should aim for. • The education that teachers receive greatly impacts how they teach and how they interact with girls and boys. Lack of gender equality and inclusion training is a significant barrier to creating more inclusive and supportive education for all. This may be especially problematic in relation to STEM, where gender stereotypes are often firmly entrenched.
Parents and family	<ul style="list-style-type: none"> • Parents may expect sons to do well in STEM subjects but have lower expectations for daughters, and thus give them less encouragement in these subjects. • Girls are often more influenced by parental expectations for career paths or other future roles than boys are. If their parents are not keen for them to pursue a STEM career, girls may feel less able to object than their brothers. • Parents who have STEM-related careers are more likely to encourage daughters as well as sons to study these subjects.

	<ul style="list-style-type: none"> Girls whose mothers have a higher level of education may be more likely to study and do well in STEM subjects. Boys are often more likely than girls to engage in science-related activities outside school, including playing with technical toys chosen by parents and family members.
Peer influence	<ul style="list-style-type: none"> Girls and boys can be very influenced by their peers' attitudes and behaviour. Girls in particular may be discouraged from pursuing STEM subjects if their peers express the view that the subjects are too difficult or that a future STEM career is not suitable for girls. The presence of girls in higher years who have done well in STEM subjects can encourage younger girls to continue studying these subjects.
Self-perception	<ul style="list-style-type: none"> Girls and boys are exposed early in life to stereotypical ideas about their roles in life, and to the view that boys are better at maths and science. This can influence their self-perception and later their self-selection of study subjects. The older they get, the more girls are likely to appear to lose interest in STEM subjects, often because of growing peer and social pressure to conform with expected female roles. Girls are more likely than boys to believe they cannot do science and maths tasks easily or successfully. Girls may lack the confidence to focus on STEM study and career paths because of the negative attitudes or sense of 'not belonging' that they anticipate facing if they try to challenge the gender stereotypes.
Community and society influence	<ul style="list-style-type: none"> In communities and societies where girls and women experience greater equality generally, there is more likelihood of them being supported and succeeding in STEM studies and career paths. The media – from newspapers and magazine to TV and film and social media – can influence girls' self-perception and ambitions and the way their families and teachers react to their study and career interests.
Curriculum and materials	<ul style="list-style-type: none"> The stereotype that women should not be employed in STEM careers is often reinforced through the curriculum and related materials. For example, a science or history curriculum may guide teachers only to teach about men who have been important scientists or inventors. This reinforces how the media and history books have often ignored the role of women in important scientific and mathematical discoveries over the centuries. Textbooks are often more likely to feature male characters or images of men working in STEM roles, with health-related and domestic science content more likely to feature female characters or images of women.

	<ul style="list-style-type: none"> • Opportunities for hands-on learning in and outside school are important in STEM subjects, and such opportunities are often more available to boys than girls.
Differences within STEM	<ul style="list-style-type: none"> • Even within the broad range of STEM subjects there may be differences. For example, studies have shown girls may be more likely to study and pursue careers in science and medical subjects than maths and engineering, manufacturing and construction.



Self-study and/or group activity

- Work on your own or in a group.
- Reflect on what you have read/learned so far in this training.
- Think about or discuss the teaching of STEM subjects in your school or a school you know well.
- Draw a mind map. Write down the reasons why you think girls may be excluded from or within STEM studies in this school.
- Then, for each of these reasons, think about ideas that have been tried to improve the situation, or ideas that could be tried.
- Think about who needs to be involved.
- Choose at least one solution idea that you can be directly involved in. Write some more detailed notes about how you could take this idea forward.

If working in groups, the groups can share their ideas with each other. If working alone, try to discuss your ideas with at least one colleague. You could also use your ideas as the basis for a class discussion with girls and boys, to find out what they think would help improve gender equality in STEM subjects and careers.

Read the information about possible interventions provided below and compare these suggestions with your own ideas.

Improving girls' and women's inclusion in STEM subjects

- Give girls more opportunities to engage with and feel they belong in STEM subjects, for instance through arranging fun and educational visits to STEM companies or research facilities.
- Science and technology companies and researchers from universities can be encouraged to run activities within schools. They can run projects which give girls opportunities to experience new technology, and through which the students can even make useful contributions to the researchers' or company's activities (see **Box 1** for an example).
- Ensure girls have access to female role models who are studying STEM subjects at a higher level and/or working in STEM careers. This might also include buddying or mentoring schemes. It also includes lobbying for more positive portrayal of women in STEM careers in the media.
- Many schools arrange work experience weeks for older children, or summer schools or study camps. Ensure girls are encouraged and offered STEM work experience and/or study opportunities when these sorts of events are organized.
- It is always important to encourage parents to play a role in their children's education. This sometimes involves awareness or education programmes with parents. When doing this we need to ensure we remind mothers and fathers to encourage girls and boys to engage in a range of STEM and non-STEM subjects, to play with a range of toys and games, and so on.
- Ensure there are high quality female teachers of STEM subjects in school. At a school level this might involve supporting female teachers to do more in-service training and continuous professional development in STEM subjects. At a national level this might also require policy changes to ensure more women are supported to train as STEM teachers and given equal deployment opportunities.
- All teacher education should include raising teachers' awareness of and ability to promote gender equality. Such training may also need to be revised to ensure male and female teachers understand and help to tackle the barriers to girls' participation in STEM subjects.
- STEM curricula and materials should be reviewed and revised to ensure they use gender-neutral language, portray women and men in STEM roles, and feature female as well as male scientists from history and current affairs.
- Ensure that girls have access to gender-responsive career guidance that enables them to see all career options and encourages them to believe that STEM options are viable for them.
- There may, in some contexts, be a need for financial support systems – such as scholarships – to enable more girls to enrol in studying STEM subjects or to attend schools that have high-quality STEM teaching.



Box 1 Linking schools with science research

An astrophysics research project, called Global Jet Watch, coordinated by Oxford University in the UK, linked up with schools in four countries: Australia, Chile, India and South Africa.⁴

The project investigates the phenomenon of black holes and wanted to set up observatories in different parts of the world, so that data could constantly be collected from different time zones, either by researchers on the ground or remotely. A decision was made to locate the observatories, equipped with powerful telescopes, in schools. This gives secondary school students a unique opportunity to learn about astronomy and get involved in the process of collecting and analysing data from the observatory in their school. They also learn about meteorology, to work out when

the weather conditions are suitable for taking astronomical observations. The lead researcher from the university was particularly keen to encourage more girls to engage in STEM studies, and selected schools where this would be possible.

One location for an observatory is a girls' school in Southern India. However, the school did not have a sufficiently reliable electricity supply, so the students at the school, and the university researchers were missing opportunities to observe and collect data. The project therefore installed a solar farm at the school. This gave the girls at the school an additional STEM learning opportunity, and one that was directly relevant to their lives and communities – learning about technology for renewable energy.

⁴ See: www.globaljetwatch.net/.



Further reading

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