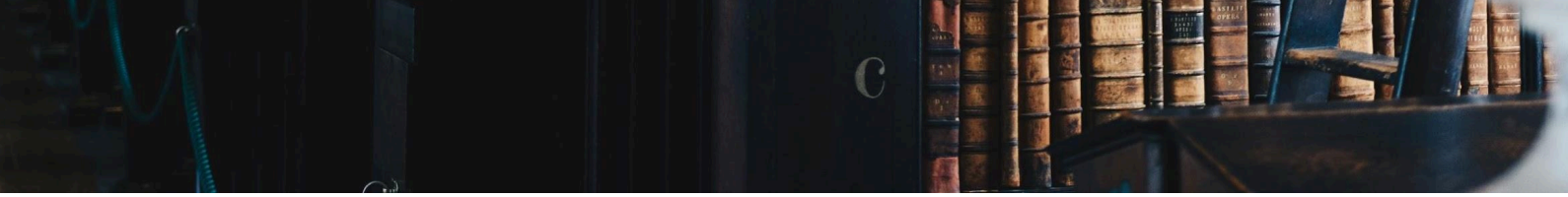

WOMEN STEM UP

ONLINE TRAINING PROGRAM WOMEN STEM UP: GENDER AND INCLUSION IN STEM AREAS

ERASMUS + KA220-HED - Cooperation partnerships in higher education

2022-1-SE01-KA220-HED-00008623

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Disclaimer

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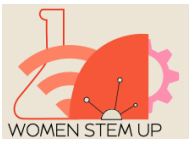
WOMEN STEM UP

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Executive Summary

1 INTRODUCTION

Welcome to the WOMEN STEM-UP web-based gender-awareness course for teachers in higher education. Paying attention to gender and equality is about how we look at each other as human beings. All students should be treated equitably by teachers and other students. Likewise teaching should be structured so that it does not disadvantage students, regardless of sex, sexual orientation, race, ethnicity, age, disability, religion, and socioeconomic status. Historically speaking, modern science is marked by western white cishet (1) able men's way of looking at the world, our bodies and knowledge. This legacy gives us, we who train the technology developers and problem solvers of the future, an important task to meet our students in a way that makes all students feel welcome – anything less is a waste for both society and the individual.

This web-based course is a part of the EU-funded project WOMEN STEM-UP, a comprehensive training programme for equipping STEM university professors and lecturers with knowledge, skills and tools for creating a more inclusive learning environment. The focus of the course is to increase women in STEM, but it includes awareness of other marginalized groups as well. The authors of the course are presented here.

"More girls are in school today than ever before, but they do not always have the same opportunities as boys to complete and benefit from an education of their choice. Too many girls and women are held back by biases, social norms and expectations influencing the quality of the education they receive and the subjects they study. They are particularly under-represented in science, technology, engineering and mathematics (STEM) education, and consequently, in STEM careers.

This gender disparity is alarming, especially as STEM careers are often referred to as the jobs of the future, driving innovation, social wellbeing, inclusive growth and sustainable development."

Girls' and women's education in science, technology, engineering and mathematics (STEM) | UNESCO [2023-10-11]

Photo: A girl constructing a space rocket with more rocket and technology, created by Copilot 18 september 2024 3:45 pm

Equality in education is about ensuring that everyone has the same opportunities to access and benefit from education. A gender oriented and inclusive approach focuses on:

Minimizing the risk of a learner's gender having negative consequences for the learning process and study environment.

Ensuring that the teaching and study conditions are designed to give all students equal opportunities to succeed in their studies.

Engaging every person's knowledge, experience and values to influence the development of undergraduate education in STEM areas.

Furthermore, gender and norms are strongly related where norms are the unwritten rules or expectations that guide the behaviour of a group or society. Gender norms are the norms that relate to how people of different genders should act, express themselves, and interact with others. Gender norms can vary across cultures and time, and they can affect people's health, well-being, and opportunities in for example education.

Equality in education is about ensuring that the content of the teaching and teaching methods show all people as equal. Regardless of gender identity, everyone should feel included and

represented in what they learn, gender norms can here be an issue. Hence, equality in education contributes to improving learning outcomes for all students. By ensuring that all students, regardless of gender, have equal opportunities to succeed, the standard of education increases.

(1) The term cishet (pronounced sis-het) refers to a gender identity and a sexual identity. It refers to people who are both cisgender (their gender identity aligns with the sex they were assigned at birth) and heterosexual (romantically, emotionally, and/or sexually attracted to people of the opposite sex).

1.1 ABOUT THE COURSE

As teachers, we are all role models, and how and what we do affects the students whether we are aware of it or not. Gender-inclusive teaching methods are based on the knowledge that gender is significant in learning, knowledge and teaching. Reflecting on your own role and identity in your interactions with students is a central part. Conducting gender-aware teaching involves becoming conscious of how students are perceived, then challenging gender norms and preconceived notions, which can lead to discussions and conversations and also challenge one's own ideas and unconscious views.

Both fellow staff members and students can be great discussion partners: ask them what subjects they want to talk about, and feel safe doing so — and what you yourself can learn from them and their experiences. We can learn as much from students as they can from us teachers.

A course cannot include everything, and a perfect course does not exist; similarly, it is okay to make mistakes but it is important to learn from them and self-reflect on one's own biases, privileges, power dynamics, identity and in general your own situatedness.

"Do not hesitate to be the killjoy in the room and call out misbehavior – especially as teachers" (quote from a student at Linköping University spring 2024)

The setup

The course includes 5 modules and some additional material. Each module contains a number of chapters, which can be reached from a link at each chapter heading. It is possible to navigate freely between the different modules and chapters, but it is recommended that you take them in order.

All 5 modules end with questions to help you reflect on your work as a teacher, along with suggestions for how teaching teams can process the material together.

1. Gender balance through language

1.1. List of terms

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5. Summary and evaluation of the course knowledge bank and FAQ

1.2 HOW TO COMPLETE THE COURSE

Each module requires approximately 15 to 45 minutes of reading time. However, each module also includes considerations and reflective questions. While you can complete these tasks independently, discussing them with colleagues can provide additional insights and perspectives that can enhance awareness of gender and equality at your university.

We hope this course will give you a foundation for understanding and dealing with situations and events that you may encounter as a teacher working for a more gender-inclusive and equal education.

1.3 EXPECTED OUTCOMES OF THE ONLINE TRAINING PROGRAM

We expect an increase in the understanding of the importance of considering gender equality and inclusiveness in daily training in higher education as well as a contribution to diminishing gender inequality issues in higher education and specifically in the STEM areas. Be aware that we, as teachers, due to our personal experiences and values, unconsciously convey notions of gender that lead to some students being partially excluded.

Therefore, we invite you to question more things around you and open more discussions both in and outside of classes.

Good luck/ The WOMEN STEM-UP working group

1.4 BACKGROUND

Despite notable progress in STEM education and an increasing focus on gender equality within research and policy, women in Europe continue to be under-represented in STEM careers and among graduates in STEM-related fields, see figure below and Addressing the gender gap in STEM education across educational levels, 2024 (2). Educational barriers include non-inclusive curricula, stereotype-reinforcing teaching practices, and a lack of female role models. However, there is a gender-equality paradox. In countries with greater gender equality, women are encouraged to join STEM, but many opt out due to personal interest and academic strengths. Additionally, in liberal and wealthy nations, personal preferences lead to pronounced gender differences in academic interests, influencing career choices more than in conservative, less wealthy countries. This, combined with strengths in reading, lower interest in science, and financial security, explains why fewer women in developed nations choose STEM careers (World economic forum, 2018). Gender-sensitive teaching methods are hence needed.

Futher, the European Commission predicts that Europe needs an additional one million digital experts (European Commission 2019). By facilitating the entry of more women and girls into the STEM sector, the EU could increase its GDP per capita by 3% in 2050, improving the bloc's GDP by up to 820 billion euros (European Institute for Gender Equality, 2022b). Clearly, increasing women's participation in STEM offers substantial economic benefits that could not only help the EU work towards gender parity but also combat the region's economic woes, which have been exacerbated by the COVID-19 pandemic (Women in STEM in the European Union, 2024). And above all, individuals can make a choice of profession free from unequal gender norms.

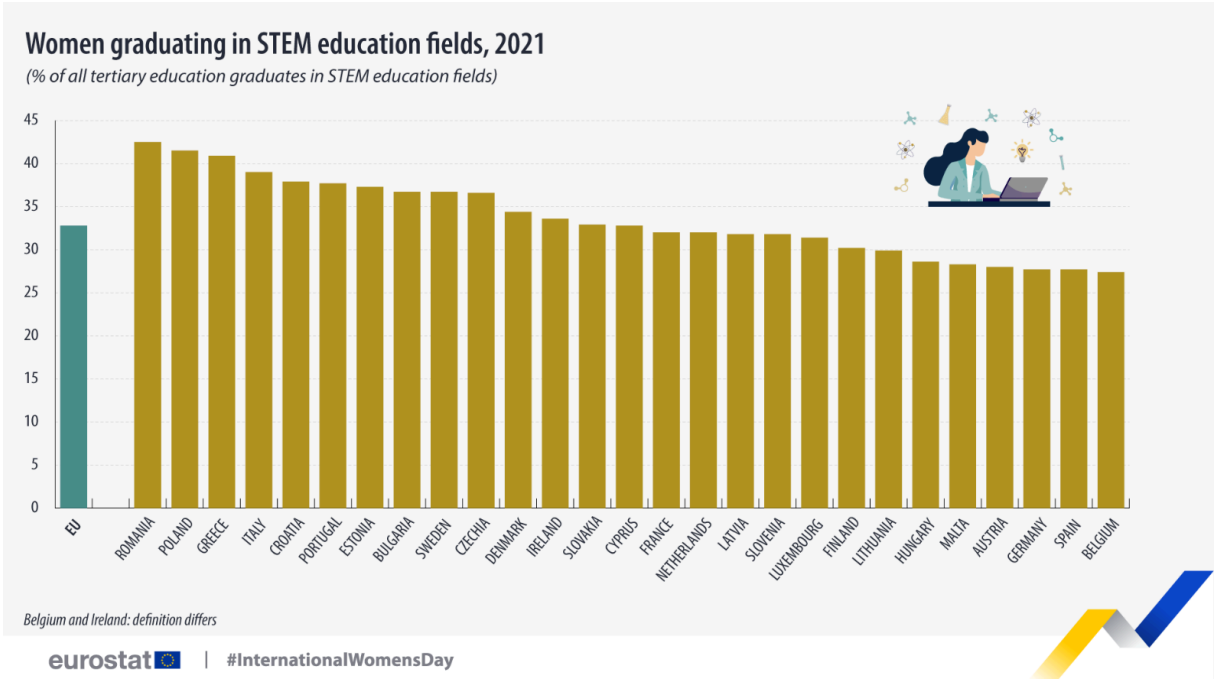
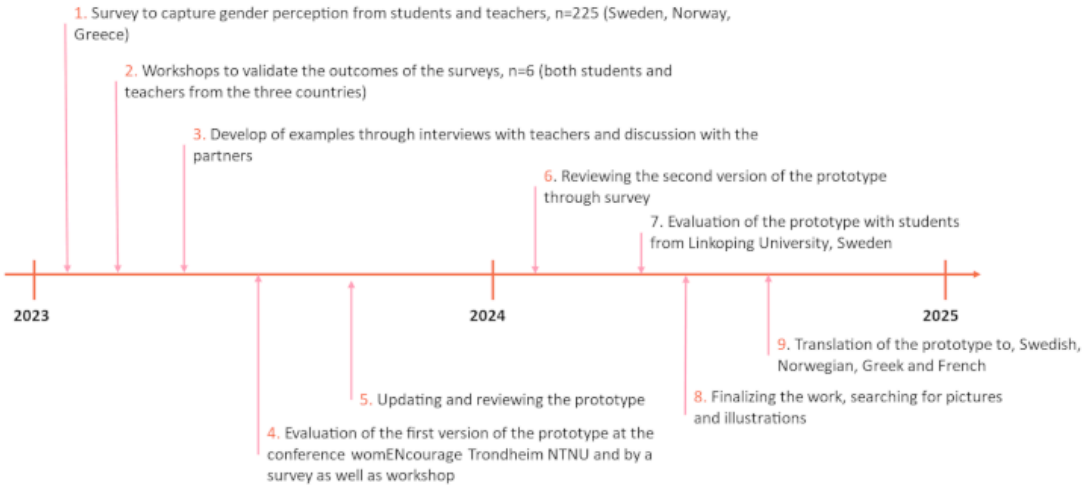


Figure from Eurostat: https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20240308-2



(2) The study concerns cis girls and cis boys and there seems to be no data on gender minorities such as non-binary and trans -or if trans, it was precised nowhere in the study.

2 GENDER BALANCE THROUGH LANGUAGE

Gender balance through language: Trainees will be supported on identifying sexist language and will be trained in gender – neutral language use. Information and examples on the use on non-restrictive gender pronouns, as well as other non-binary vocabulary will be included

1. **Why should you do this module**

We use language to communicate with each other, so the vocabulary, structures, and topics we use have a great impact on what message we end up sending to the other person.
Language use has a crucial role in creating an educational environment that is gender-inclusive or that is exclusionary

2. **Questions to start the module with**

- Do you know what the difference is between “sex” and “gender”?
- How many genders are there?
- How does language contribute to a gender-inclusive classroom?
- Why should you use singular “they” in education?

3. **Module’s objective**

- To explain the terminology connected to language use and gender-inclusivity
- To give examples about what to consider in your educational practice
- To give you some literature to consult before putting together your class

2.1 List of terms

List of basic terms

Many people think of the terms “sex” and “gender” as interchangeable. While these two terms are connected, the picture is not as simple.

Sex

Sex is generally assigned based on a baby’s genitalia

Gender

Gender refers to the social attributes and opportunities associated with being male and female and the relationships between women and men and girls and boys, as well as the relations between women and those between men. These attributes, opportunities and relationships are socially constructed and are learned through socialization processes. They are context/ time-specific and changeable.

Gender determines what is expected, allowed and valued in a woman or a man in a given context. In most societies there are differences and inequalities between women and men in responsibilities assigned, activities undertaken, access to and control over resources, as well as decision-making opportunities. Gender is part of the broader socio-cultural context.

Overview of basic terms

SEX is what you were assigned at birth, based on a combination of physical features

GENDER IDENTITY is your innermost concept of self as female, male, a blend of the two, or something else

GENDER EXPRESSION is the external appearance of your identity and what others perceive of you

Some other relevant terms

GENDER ROLE is the set of functions, activities, and behaviours commonly expected of girls/women and boys/men by society.

GENDER STEREOTYPES is a generalized view or preconception about attributes or characteristics, or the roles that are or ought to be possessed by, or performed by, women and men. A gender stereotype is harmful when it limits women's and men's capacity to develop their personal abilities, pursue their professional careers and/or make choices about their lives

GENDER LITERACY is the ability to participate knowledgeably in discussions of gender and gender-related topics.

2.2 Gender balance through language

The vocabulary of gender continues to evolve and there is no universal agreement about the definitions of many terms.

Nonetheless it is always worth doing our best to stay informed. The precise use of terms in regard to gender can have a significant impact on overcoming many of the misperceptions and biases associated with gender.

"in all written documents and where appropriate and feasible in oral expression, either explicitly use the female and male forms or gender-neutral terms."

Inclusive learning environment

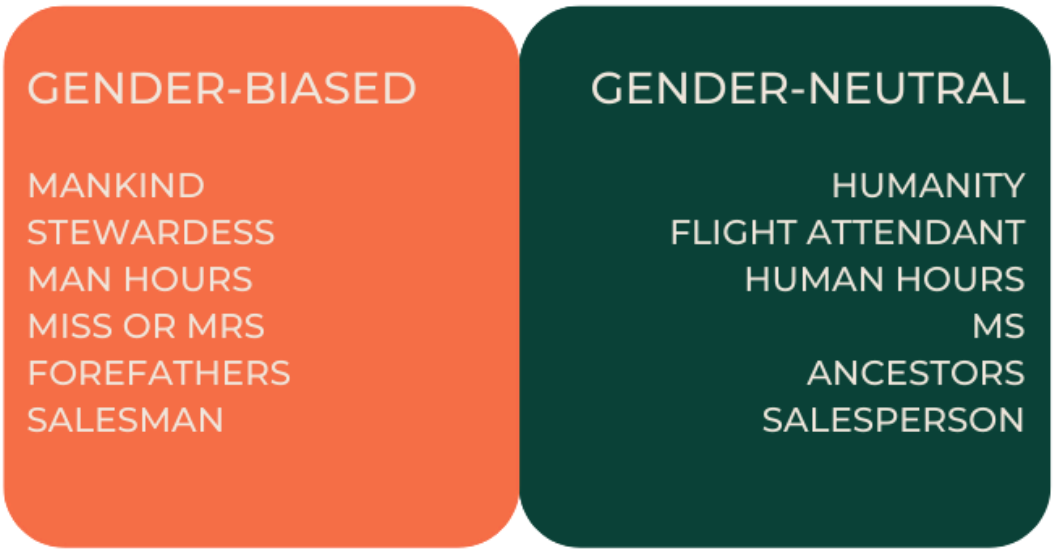
- Inclusive pedagogical environment is a philosophy of teaching that ensure equal opportunities for all students to have a successful learning experience. An inclusive pedagogy must engage both majority and minority students through participation, collaboration and good relationship in both student-student relations and student-teacher relations .
- The academic dimension of inclusion depends on adaptations of the curriculum, adapted assessments, adapted teaching, high-quality education, learning outcomes, and higher achievement levels.

2.3 Examples of inclusive language

What language you use matters even in STEM classes. Even if you feel you are working with hard science, your choices related to the way you communicate it influence your students.

In the following you will see some specific examples to consider when preparing for and giving your lectures and seminars.

Vocabulary that assigns gender



- **Pronouns: singular "they"**

The most gender-inclusive way to talk about a person in English is to use singular "they". The singular they is used in 3 main contexts:

1. To refer to people who specify their pronoun to be "they"
2. To refer to people whose gender is unknown to us/the speaker,
3. To refer to people whose gender is irrelevant for the specific context. ("I fell on the street but somebody helped me up. It was so nice of them".)

2.4 Perception of gender in education

According to our survey, students are impacted by teachers' choice of language use.

For example, what pronouns they use, what examples they provide, what topics they choice to relate the matter to real life, as well as what textbooks they assign.

Does your class use gender-neutral language?

Do you refer to an engineer as he/him or with a male name?

Do you refer to a STEM student as he/him or with a male name?

Do you assume that your female students are less likely to know the answer?

Do you use examples that come from books authored by men?

Do you use scenarios that cover one or few interests (for example, competitive games, war, car racing, etc.)?

Some References

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Succeeding in inclusive practices in school in Norway – A qualitative study from a teacher perspective Open Access

Hanne Marie Høybråten Sigstad, Jorun Buli-Holmberg & Ivar Morken

European Journal of Special Needs Education, Volume 37, 2022 Issue 6 Pages 1009-1022, Published online: 03 Nov 2021

3 GENDER BALANCE TEACHING METHODS INTO PRACTICE

3.1 Introduction

Gender-inclusive teaching methods are based on the fact that gender is significant in learning, knowledge and teaching (Severiens and Ten Dam, 1994). This means, in turn, that teachers must reflect on the concept of gender, critically examine the significance of gender in the teacher's subject area, and question any preconceived notions we may have regarding gender and its consequences in teaching. Conducting gender-aware teaching may involve becoming aware that students are received differently depending on, for example, gender identity, and that there are different conceptions of gender identities, the expectations placed on them, and expected characteristics. In many cases, it is therefore also an inner journey for us as teachers to become aware of norms, power structures and ideas about gender.

- **3.1 The room**

When interacting with students in various academic settings, such as lecture halls, classrooms, laboratories or supervisions, the discourse is shaped by the norms and expectations of the academic community.

Teachers and students interact through various approaches; one frequent approach involves discussion and communication. Research has shown that there are gender differences in how students participate and receive feedback in these settings. Some examples of gender-based trends that influence gender bias (Grace and Gravestock, 2009) **(3)** include:

- Male students receive affirmation from the teacher more often
- Teachers give male students a great deal more attention and time than female students (independent of the teacher´s gender) .
- Teachers wait longer for males to respond to questions.
- They give male students more eye contact following questions, remember the names of male students and use these names when calling on male students.
- Male students tend to dominate the verbal space by speaking more frequently, interrupting more successfully, and receiving more attention and support for their questions and comments from both male and female teachers.
- Teachers attribute male students' comments in class discussion more often than other genders.
- Teachers ask males more questions that call for 'higher-order' critical thinking as opposed to 'lower-order' recounting of facts.
- They ask males more questions that call for 'higher-order' critical thinking as opposed to 'lower-order' recounting of facts.

The awareness of these 'gender dynamics' can avoid gender bias and the unjust treatment of learners based solely on gender in the room.

(3) The study is based on cis students and only boys and girls

- **How is the verbal space when you meet the students? Are you aware of:**
- Who speaks and who remains silent?
- Whose questions are followed up?

- Who tries to interrupt the conversation and who succeeds as well as who speaks over others ?
- Who is supported in their speeches by you as a teacher or by other students?
- With whom do we have eye contact?
- How do we ask questions and to whom?

Considerations for teaching situations

As a teacher, you can influence power, hierarchies and norms to achieve a more equal learning environment. We also have an obligation to act for the teaching to be conducted in such a way that there are equal opportunities with regard to gender. You may consider the following courses of action:

- Reflect on how you introduce yourself and interact with students (e.g. introduce your pronouns and ask students theirs, use gender-neutral language, etc.)
- If necessary, do not hesitate to change your teaching methods if you notice an imbalance between the duration of men speaking versus that of women speaking, i.e. ensure that the opportunity to speak in class is more evenly distributed.
- Examine yourself and notice the way in which you give affirmation to students.
- Be aware of how you react to the oral contributions of the students and the relative significance given to women's and men's contributions to the teaching.
- Pay attention to the conversation space (conversational tone and speech space) regarding gender.
- Reflect on how you deal with and receive different students' questions and comments (e.g. which questions are followed up or later used as examples)
- Create strategies for everyone's participation in seminars, discussions, group work and other conceivable teaching situations
- Create a strategy to facilitate students' ability to take up space in the classroom without feeling judged or watched
- Reflect on how you deal with and receive different students' questions and comments (e.g. which questions are followed up or later used as examples)

It is challenging to be fully conscious of and handle the gender dynamics in the classroom, since they involve general patterns that seldom manifest themselves in clear-cut ways. These are, thus, general trends and not something that happens in every teaching scenario. We cannot, therefore, presume that individual women and men will always behave according to these patterns.

3.2 Examination and feedback

This refers to the fair and equal treatment of people based on their gender in examination settings. There are many issues and challenges related to examination and gender. Your ideas about gender can influence your assessment of a text. On many occasions we base our reading on the assumption that a particular sex has produced the text, and we include our ideas about people based on sex.

It is recommended to

- Use anonymous exams.

- Use varying forms of examination to take students' different learning styles and ways of expression into account.
- Have both women and men as examiners.
- Use a previously developed assessment matrix to evaluate projects and students' performance to evaluate everyone equitably.

To Consider:

- Reflect on how you read, assess and evaluate the students' tasks and texts. Pay attention to and critically examine the criteria that you use in assessing the students' work.
- Be continuously aware of the criteria you use for assessing laboratory sessions, exercises, etc., and examine these critically on a regular basis.

To discuss with colleagues:

- How do I assess and evaluate the students' tasks and texts?
- What criteria do I use for my assessment and how do I communicate the assessment to the students?

3.3 Course information

The target group for the course information is primarily the students, but also the course team itself and the administration. Course information is the common term for all information relating to the course and includes planning and information.

It is important to provide context and purpose for the course content. The context of the course should be explained, including the purpose of the content and how it relates to other courses in a study programme (if applicable). The purpose of the course content should be clearly stated, and the question of what students should use the content for should be answered. For example, students should be informed of why they should read the content and how the knowledge can be used in their future professional lives. This will help students understand the relevance of the course content and how it can be applied in their future careers. It is also important to have a strategy for communicating questions and answers to all students in the course, not just those who ask (e.g. post all questions and answers on the web).

Recommended content for course information

- A clear goal of the course, learning outcomes, and how it matches all course elements.
- Information about how the communication is managed in the course, from students to teachers and vice versa.
- Information on how students get feedback on assignments.
- Details of course supervisor, course team and examiner for the course, name, surname and contact information.
- Description of how the students can express their opinions about gender, sex, and equality in teaching, for example through course evaluation during and/or after the course

Description of how students can report abusive discrimination

- If you, as course supervisor/examiner, have considered equality and gender in form and content, this should also be stated.

- Information about how students' opinions are taken care of and influence the development of the course.
- "Title" of the moment, time, place, and teacher's signature.
- "Title" followed by a description of the content of the part.
- A literature reference bibliography for each section where relevant.
- Examinations, their content, and number of points.
- The link between course objectives and examinations.
- Information on grading criteria for each level.
- Refer to the authors of the course literature indicating name and surname.

Check that:

- The exams and other forms of evaluation match the syllabus.
- All information is available to all students.
- All contact information for teachers, course assistants and administrators is available.

3.4 Course literature

When it comes to course literature, it is important to have a diverse range of authors, including gender and also other marginalized identities. This is because having a variety of perspectives can help students gain a more comprehensive understanding of the subject matter. Additionally, it can help students develop critical thinking skills by exposing them to different viewpoints and ideas. Furthermore, it can help promote gender equality by ensuring that all genders are represented in the course material. Finally, it can help students develop a more nuanced understanding of the world around them by exposing them to different experiences and perspectives.

Continuously review the course literature used in exercises and laboratory sessions from a gender-aware perspective. Examples of aspects to consider are:

- Is there a diversity of gender present in the literature? And is there a representation of sexual/romantic orientation, race, ethnicity, age, disability, religion, and socioeconomic status in the examples discussed in your classes, laboratory sessions and group work?
- What are the ways in which different sexual orientation and other marginalized identities are presented in the course literature and in the examples used in your classes and laboratory sessions?
- What are the ways in which they are discussed?
- What do the various descriptions and explanations concerning different sexual orientation and other diversity express?
- Be aware of how different examples are described in the literature – are they intended to be read by women or men, or are they neutral in this respect?

Is it possible to:

- Use course literature written by a diversity of genders, ethnicities, etc in your course?

- To use course literature with a diversity of genders, ethnicities, sexual/romantic orientations, races, age, disability, religion, and socioeconomic status etc are represented in examples and pictures?
- To apply a gender perspective to existing research (e.g. problematized when literature is missing from one of the genders, research results based on one of the genders or prejudices are expressed regarding gender)?

Check that:

- Check that (as far as you can*) that the course literature is "free" from discrimination (i.e.: gender, transgender identity or expression, ethnic affiliation, religion or other belief, disability, sexual orientation and age).
- That there are easily accessible avenues for reporting and encourages students to see you if they notice something of privileged identity or discrimination.
- Be prepared to talk and discuss it in class.

*Nothing and no one is free from discrimination as we all come from various backgrounds and have some privileged identity one way or another which creates biases and biases in our experiences.

To discuss with colleges:

- How does the representation of gender in the chosen literature affect the outcomes of the course? Is gender equality discussed in relation to the selected literature and its content, or is it purely a discussion about, for example, the representation of gender in literature?
- Are the students expected to acquire knowledge about gender, equality, and diversity? Are such theories used to shed light on various phenomena? Is gender equality addressed in relation to sustainable development, laws, and regulations?
- Are multiple gender and other marginalized identities living conditions, perspectives, and experiences made visible?
- Are design processes based on principles such as design for all, inclusive design, and universal design?
- Are the students given the opportunity to reflect on gender, norms, and power?

3.5 Group work

Roles and tasks within groups

Group leader and secretary are two common roles that emerge in groups. Other roles include follower, timekeeper, process advisor (who monitors and provides feedback on the group process, such as conflicts and participation), idea generator and executor (who implements the ideas (Inspired by G. Gibbs (1994) Learning in Teams. A Student Manual (Oxford Brookes University)). Additional roles are responsible for the work environment and administrator. The assignment of roles may depend on personal preferences, qualifications, or learning needs. Some roles may be fixed for each meeting, while others may vary and be initiated by different group members. The roles can be beneficially rotated. The students can determine how explicit the role division is and whether it needs to be clarified during the work. It is then important that there are chances to discuss and reassign roles. This can be specified in a group contract.

Division into groups

Gender equal groups do not automatically lead to equality. However, from the Women STEM-Up survey conducted in Sweden, Norway, and Greece, the majority of both men and women prefer to be a part of a gender-mixed workgroup and a smaller part (10-20%) don´t care if it is mixed or not.

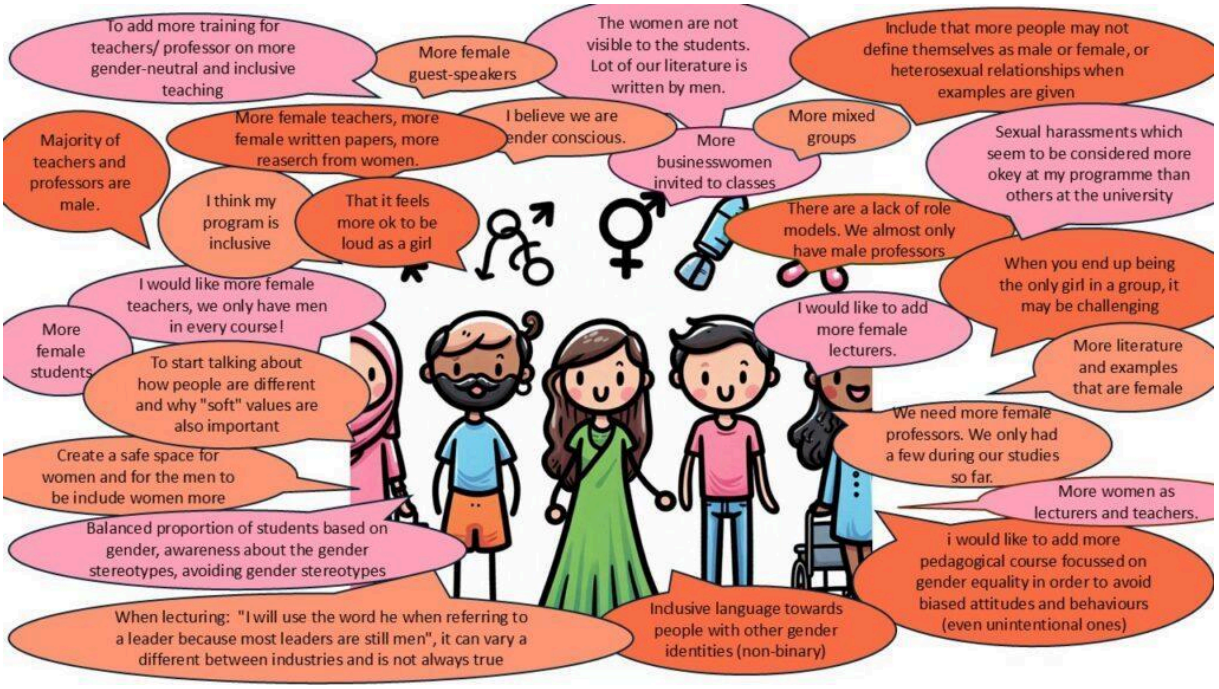
Note: Survey results from 167 respondents studying to become civil engineers in industrial economics and management as well as computer science.

Group work considerations:

- How does the group division take place?
- How is the work distributed during projects and laboratory sessions?
- How does the role distribution look and who takes on different types of tasks?
- How can I help the students try out different types of tasks and roles?
- How do I help the students to create a good, functioning group?

3.6 Students' perceptions of gender

The quotes below are from the Women STEM-Up survey conducted 2023 in Sweden, Norway, and Greece, 167 respondents studying to become civil engineers in industrial economics and management as well as computer science, answering the question “To make your program more gender-neutral and inclusive: a) what would you like to change? b) what would you like to add?”



3.7 To avoid master suppression techniques

Master suppression techniques have shown to have a big impact on the quality and effectiveness of teaching and learning. They are defined as strategies of social manipulation by which a dominant group maintains such a position in an (established or unexposed) hierarchy. It is important to avoid diminishing master suppression

techniques in the interaction between teachers and students and between students.Teachers need to develop empathy towards attitudes that break gender-based stereotypes in class activities, for example group work. We'll discuss 5 master suppression techniques (Making invisible, Heap blame/put to shame, Ridicule, Withholding information, Double bind) and ways to counteract them, which is important to improve interaction in the classroom, projects and group tasks.

Making invisible

The technique of making a person invisible conveys that the material provided by the person is not important or useful. The aim is to make the person feel insignificant and insecure. The technique can be applied in a direct form with words and/or body language, or it may be used indirectly.

Direct

- The name of the person is not used.
- The work of a person is referred to in dismissive terms.

Indirect

- Attention is directed away from the person through disturbing noise such as the scraping of chairs, rustling of papers, coughing, etc.
- No one takes any notes or poses questions that show they are listening.
- Someone repeats what the person has just said as if it were their own idea.
- If someone is forgotten, dismissed or met with anything other than genuine interest, this person may be the target of this technique.

Photo: **Making invisible – students making another student invisible when group working, created by Copilot 28 October 2024 08.43 am**

Counter-technique – Give space and visibilising

- Action should be taken immediately, and it must be made clear that this behaviour is not acceptable. On occasions when a student is talking without being acknowledged, it may be a good idea to stop it and make the point that it is important to everybody to listen properly.
- It is important in this situation not to demonstrate anger or frustration, only calmly claim your rights or the person in question rights to demand attention to avoid becoming a victim or feeling belittled.
- It can also be good to draw up rules for how learning activities should take place, such as making sure that everyone gets to speak and what can be done to facilitate that. For example, that everyone is allowed to think for themselves first before the discussion begins or that there is a signal to get to the floor such as raising your hand or a ball being passed around.
- It can be necessary to make the perpetrator aware of what you experience as unacceptable behaviour. “Did you say…?”, “Do you mean that…?”, or “Well, I think you have neglected to introduce X by name”.

Ridicule

Ridicule is, for example, making jokes at the expense of others. It may also be presenting another person or their arguments as silly and unimportant; using, for example, striking but inapplicable comparisons. One version of ridicule is infantilization. This involves treating someone as a child, and taking on the role of the adult who knows best: (“Oh, honey/sweetie/my dear girl, what on earth are you doing?”). Whatever the subject of the

ridicule subsequently says or does, the person has a lower value in the eyes of others. Being exposed to ridicule may cause a feeling of worthlessness.

Photo: **Ridicule – devaluing a student's performance, created by Copilot 28 October 2024 09.28 am**

For example:

- A student attempts to present something important, but the classmates laugh at the person's accent and say that the person sounds like a person in a popular TV series.
- A classmate makes disparaging remarks about another appearance in front of other people.
  Counter-technique – Questioning and Respecting
- Do not allow jokes or comments based on ridicule to pass unnoticed. Never join in the laughter but bring the conversation to a halt and request an explanation or mark the inappropriate behavior.
- Remain composed and logical and make it clear that you do not accept this treatment. Analyze the ridicule and ask the perpetrator to clarify what is meant. It can be helpful to repeat what has been said verbatim and ask for an explanation ("What do you mean when you say that a woman or X would not be able to deal with it?").
  Validation technique – Respecting
- Respect and treat all people seriously. Pose questions about the ideas and points of view of others, in order to give them mental space.

Withholding information

Withholding information involves keeping someone in the dark about certain matters. People are excluded or marginalized when significant information is withheld from them. It is more difficult to act correctly when a student is not privy to all relevant information. It is also possible that the student will start to doubt their own opinion in certain matters.

Photo: **Withholding information for a student, created by Copilot 28 October 2024 10.13 am**

For example:

- A student is not invited to a group meeting at which the student should have been present.
- Decisions that should have been made in a meeting have already been made in an informal context which was not accessible to everyone involved.
- Teachers or others involved in the teaching email information to only certain students but it affects everyone

Counter-technique – Cards on the table

- In situations in which matters have been discussed and solutions drawn up without your participation, remind the others that you are all members of a working group to which everyone must be allowed to contribute. It is also possible to compliment the people who have held the discussions in your absence, and then to ask them what they have concluded and how they did so, before any decision is made.

- If you have been repeatedly subjected to the withholding of information, point this out to the person in charge and indicate that there are structural issues at work that result in your not receiving the information you are entitled to.
- Assume that the withholding is a consequence of poor information management or of people being unaware of their behavior and its consequences.

Validation technique – Inform

- Make sure that you inform everyone and include them in decision-making processes. Make sure that quieter individuals are heard. If projects are discussed outside of working hours, be prepared to inform the remaining group members of the conclusions you have reached and explain how.
- **Double bind**

The double bind leaves the student feeling that whatever choice the person made, it will be the wrong one. If the person works conscientiously, the student may be described as slow, but if the student works rapidly, the person is accused of carelessness. It may also be a case of the priorities the person assigned. To be punished no matter what choices a student makes can lead to that student investing all of the time and energy into trying to "do the right thing". This means allowing other people to tell the student what to do and how to do it. The student has become powerless.

Photo: **The double bind scenario, created by Copilot 29 October 2024 08.23 am**

Counter-technique – Break free of the pattern

- Support the student to consider their own priorities and understand how they reach them. They should inform others who are affected by their choices of the priorities they have set. It's important for them to remember that they know what is important in their life and what is important to them.

Validation technique – Double reward

- Be a good role model for the students. Try to view things from the perspective that students and others involved in teaching do as well as they can in the circumstances. If a person arrives late to a meeting, it may be more rewarding to believe that the person did his or her best to arrive on time. Then, use this as an opportunity to hold a discussion about the importance of arriving on time. Take this approach rather than becoming irritated.
- Share your perspective with the students, for example, that you understand that when a person declines to participate in a certain activity it only means that the person is declining the activity, not the relationship itself.
- It can also be part of a group contract, for group assignments, to discuss how the students view the distinction between action and person and the other master suppression techniques can be avoided.
- **Heap blame/put to shame**

The last master suppression technique is when someone makes another person feel ashamed or guilty for an action or situation for which the other person is not to blame. This may manifest as a mixture of the other master suppression techniques, with the result that the person internalizes the message and blames himself or herself.

For example:

- No one listens to what a student or a person says at a meeting, and they feel that they have expressed themselves poorly or imprecisely.
- A student has been given too many tasks when group working, which leads to having a bad conscience because not completing them, rather than taking a critical look at the work situation.

Counter-technique – Intellectualization

f you as a teacher witness this technique mark that the behaviour is not okay. However, it can be difficult to be nearby when there is, for example, group work. It is good if you have facilitated the student networks with group contact where the techniques are discussed and what the students themselves can do in such a situation. This can be advice to students in a situation: Try to realize that your feelings of guilt or shame have been imposed on you by someone else. Try to critically examine your situation: describe why you feel guilt and where this feeling comes from. Could it be that someone tried to "dump" their own guilt on you to save their own skin?

Validation technique – Affirm others

- Affirm the right student in class, see 2.1 The room for situations to avoid.
- Set reasonable standards and support the students in conflict resolutions.

3.8 Reflecting on putting gender balanced teaching methods into practice

This part of the online course ends with some questions that can be discussed with a group of colleagues.

- Select five or so questions from the questions below
- Then, brainstorm and write down some supporting words on your own (5-10 min)
- Then talk in pairs about your thoughts and reflections, each person speaking for an equal amount of time (10-15 min)
- Finally, discuss in the larger group (15-20 min)

Questions to discuss with colleagues

- What obstacles prevent women and other gender minorities from advancing in STEM academic careers?
- How can universities ensure that all, regardless of gender, have equal access to resources and opportunities?
- How can universities promote a culture of equity and inclusion?
- How can universities support students who experience discrimination or harassment based on gender?
- How can universities foster an environment where all students feel welcome and included?
- Do you believe that gender is significant in learning, knowledge and teaching? Why or why not?
- Why is it important to work with more gender-inclusive teaching at the university?
- What role do you think universities have in advancing gender equality?
- What gender aspects are there in your teaching subject?
- What knowledge and attitudes do the students need during their education?
- What knowledge and attitudes do the students need when they enter the working world?
- How do you work to integrate gender-balanced teaching?
- What norms and values characterize the activities at our university/department/course:
- — in conversations about the students?
- — in the choice of literature?
- — in how students are divided into groups?
- What climate do you offer the students in the classroom?
- How do you distribute the word and the speaking space in the classroom?
- the teaching situation.
- How do you make changes in your teaching method when you notice that a pattern is emerging where speaking time between people of different genders is unevenly distributed?
- How do you make yourself aware of how you pick up what the students say and what significance women's and men's marginalized groups' contributions have in the teaching? For example, who has follow-up questions or are referenced later during the lesson?

- How do you handle the intersectional perspective, e.g. gender and ethnicity when it comes to all students having equal opportunities in teaching?
- How can you identify and handle master suppression techniques in your classroom? Do you have your own experiences of experiencing the techniques or have you witnessed this between students?

4 DEVELOPMENT OF GENDER EQUITABLE AND INCLUSIVE TEACHING MATERIAL

4.1 Introduction and Aim

Stereotypes and biases are important cultural factors that may influence women's representation in the STEM areas. A stereotype is an association of specific characteristics with a group (Dovidio et al., 2010). Stereotypes can be descriptive (what women and men are like) or prescriptive (what women and men should be like). Stereotypes are very powerful and difficult to override, and they can lead to biased behavior or discrimination when we view members of a group based on their group status rather than as individuals (Heilman, 2012; Dovidio J, Hewstone M, Esses VM.2010).

Teaching and learning materials are powerful tools because the images and language with which teachers and students interact can impact their understanding of a subject. Developing teaching material and examples that promote equity, inclusiveness and intersectionality (Crenshaw, 1989)[1] can help to break down gender stereotypes.

The aim of this module is to provide some examples of the importance of gender and intersectionality to help trainees to develop inclusive examples free of gender stereotypes and/or gender bias.

Figure 1: Gender and intersectionality

4.2 Gender bias and teaching examples

Educators at all levels influence how students perceive the STEM fields, as well as how students view themselves. Environmental factors, classroom gender composition and faculty gender are also significant issues that impact STEM students' engagement and success (Bailey et al., 2020; Olsson & Martiny, 2018; Solanki & Xu, 2018). Despite remarkable progress made over the last decades to mitigate gender bias in academia, gender bias still forms a bottleneck for gender equity in STEM. Breaking gender bias against women in STEM fields is a society-wide effort, as these biases can lead many women and gender minorities to gradually leave scientific careers.

Some strategies to promote inclusiveness and intersectionality, while reducing gender bias in teaching and learning materials, include:

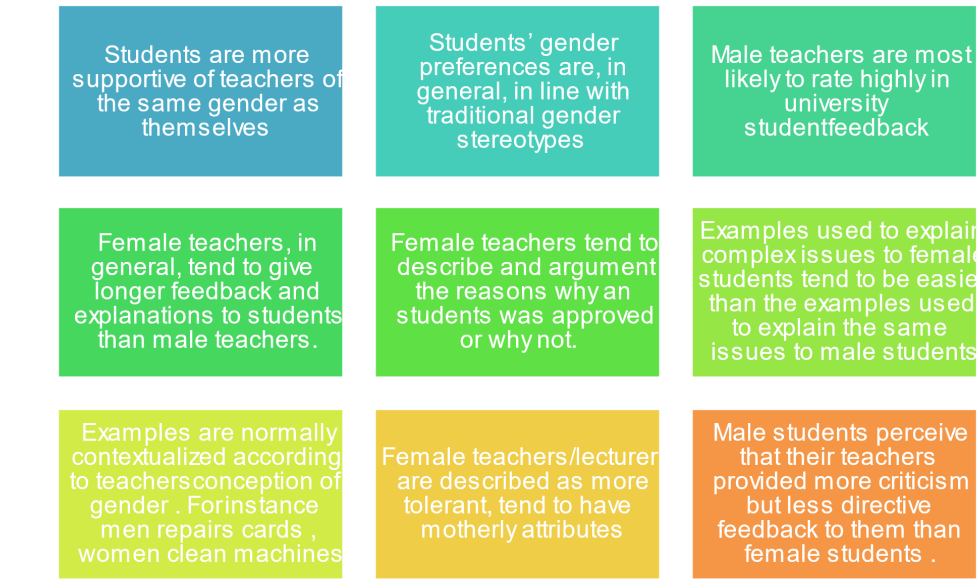
- Change cultural stereotypes that lead to reinforce gender biases for example, that men are better than women at math, science, and possess other skills that engineers, and computing professionals need.
- Women are often portrayed in soft technological areas, while men are often portrayed in more technical advanced and innovative areas. A best practice for teaching and learning materials is to

depict all social groups as equals who interact in respectful ways, through traditional and nontraditional roles.

- Making the examples socially relevant can contribute to increasing students' interest and engagement and to stimulate them to see themselves as a part of STEM areas and educational programs.
- Embed diversity in your examples, highlighting environments, technical solutions, and products that reflect multicultural issues. Focus on scenarios where minority groups are actively involved in contributing to societal and technological development and innovation.
- Change the frequency of representations. Dominant subgroups are often portrayed in teaching and learning materials more frequently and more positively than are other groups. Characters in materials should represent the range of characteristics in a society in positive and inclusive ways.
- Students identify with characters who are similar to themselves (e.g., are the same gender, have the same physical characteristics); therefore, ensuring equal representation of all individuals in teaching and learning materials can help expose to positive messages and provide powerful role models.

4.3 Breaking gender bias

Teachers frequently form attitudes based on stereotyping acquired from their own upbringing and culture. For instance, although the engineering profession does not officially exclude women, in most cultures this profession tends to favor males, thus reinforcing existing stereotypes (Blumberg, R. L, 2015). However, gender bias does not start or stop with the teacher. Many examples and teaching materials contain gender bias in activities, photos, words, images, reading materials, written assignments, or even test materials. Regardless of the subject, gender and intersectionality play a role and it is important to take them into account in our teaching.



- Reference: Vimarlund V (2019) Promoting Equity by Gender into the Classroom: Lessons learned from the development and implementation of a Web-based course. International Journal of Gender, Science and Technology, Vol.10, No.3, 2019.

Another example of gender bias is discussed in a research report developed by the research group PROGS (Psychological Research on Gender Segregation, Una Tellhed and Fredrik Björklund, 2003, Lund University). The report shown that ethnicity plays a role in gender differences. "Girls with a foreign background had better self-confidence and greater interest in programming than girls with a Swedish background. They also had weaker gender stereotypes about technology. The authors argue that this can be related to the "gender equality paradox", where gender differences in self-confidence and professional interests have paradoxically been shown to be greater in more equal countries". PROGS – Psychological Research On Gender Segregation | Institutionen för psykologi (lu.se).

4.3.1 What can teachers to improve teaching material?

Potential consumers of technology have different characteristics that influence their use of technology, such as: gender identity, sex, age, ethnicity, profession, occupation, education, income, household and living arrangements, familiarity with and attitude towards technology, and/or disability.

Engineers are currently designing new ways to communicate virtually and developing innovations in human-robot interaction, including touch, sensors, facial recognition, and speech technology. This raises questions about how gender and intersectionality should be applied and integrated into these innovations. For instance, research into human-robot touch is still in its infancy, and few studies have considered the gender of the human when interacting with a robot's "gender." The question of whether gender or intersectional identities influence the effectiveness of this technology and tactile sensation is often overlooked.

4.3.1.1 Below we listed examples that visualized gender and intersectionality in some STEM areas:

A. Gender considerations in haptic technology.

A research report from Stanford University that raises questions about how touch technology should be employed in robotics and ask questions such us: Should robot touch follow human conventions? Can touch between a human and a robot or mediating haptic device have the same meaning as it does between two humans?
The report discusses also that Roboticists need to consider a) how gender figures into human/robot touch and, b) that studies need to include: i) representative numbers of men, women, and gender fluid individuals plus robots with different gender configurations; ii) disaggregated data by gender (men, women, gender diverse); and iii) analyzed results by gender. The report Is available at the following link. "Haptic Technology: Analyzing Gender ". published by Stanford University, Gendered innovation. Haptic Tecnology | Gendered Innovations (stanford.edu) 20240826; 11 .20 AM.

B. Gender, intersectionality and social robots

Social robots are artificial intelligence platforms, paired with sensors, cameras, microphones, and other technology, like computer vision, so they can better interact and engage with humans or other robots. Robots, in general, are designed in a world with gender norms, gender identities, and gender relations, including expectations about how "male" and "female" entities should act.

Humans—whether as designers or users—tend to gender machines. However, when designing hardware toward current stereotypes can reinforce those stereotypes. The challenge for designers is therefore to understand how gender becomes embodied in robots to design robots in ways that promote social equality.

Examples of social robots can be found at the following links:
What Is a Social Robot? | Built In
Types of Social Robots – Robotics Meta
The 7 best use cases for social robots – Furhat Robotics
The 7 best use cases for social robots – Furhat Robotics

C. Sensors and intersectionality

Sensors are normally developed with white males as norm. Solutions can therefore do not be generalized or extended to people from different races or to individuals with some disabilities. Intersectionality is usually not considered and thus the solutions are not satisfactory for everyone. An example of how technologies based on color sensing reproduce racial bias is available at (Amy Moran-Thomas, 2020). Amy Moran-Thomas is Associate Professor of Anthropology at MIT. She is author of Traveling with Sugar: Chronicles of a Global Epidemic. The publication describes how a Popular Medical Device Encodes Racial Bias.

A picture of the device is available at: How a Popular Medical Device Encodes Racial Bias – Boston Review

Image: Wikimedia Commons
Race, Science
How a Popular Medical Device Encodes Racial Bias
Pulse oximeters give biased results for people with darker skin. The consequences could be serious.
Amy Moran-Thomas
COVID-19, Health, Race, Science and Technology
August 5, 2020

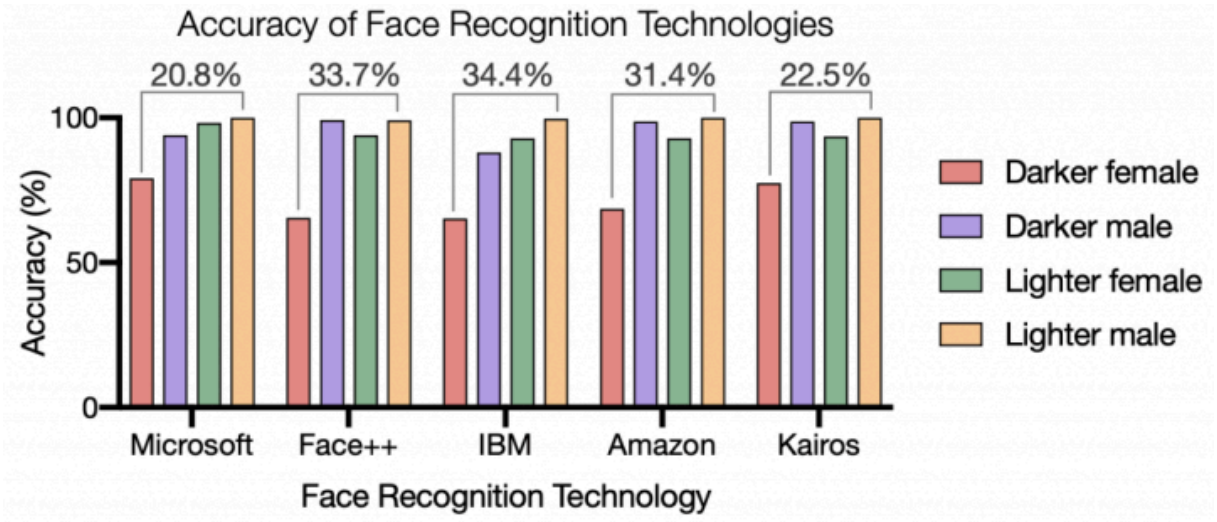
D. Gender and Facial recognition systems (FRSs)

(FRSs) can identify people in crowds, analyze emotion, and detect gender, age, race, sexual orientation, facial characteristics, etc. These systems are often employed in recruitment, authorizing payments, security,

surveillance, and unlocking phones. Despite efforts by academic and industrial researchers to improve reliability and robustness, research studies demonstrate that these systems can discriminate based on characteristics such as race and gender, and their intersections (Buolamwini & Gebru, 2018).

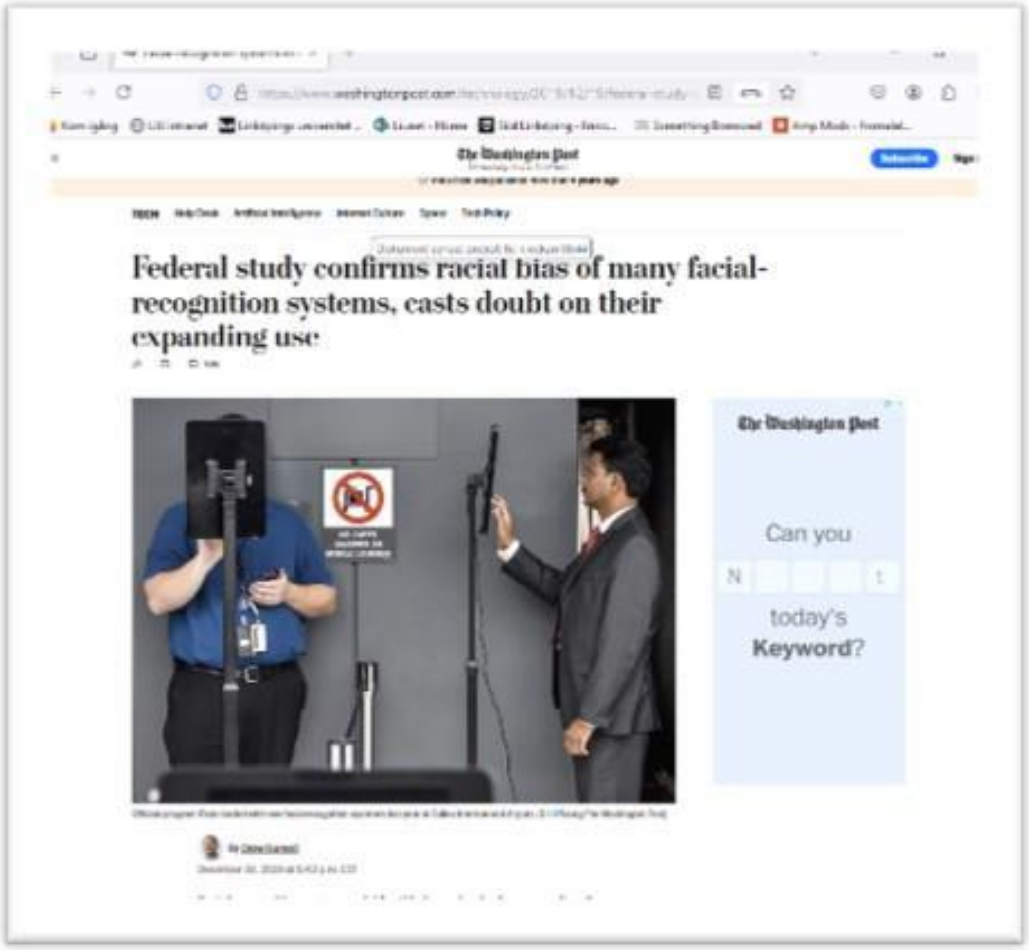
Joy Buolamwini, author of the book "unmasking AI: My mission to protect what is human in a world of machines, 2023" looks at the social implications of the technology and warns that biases in facial analysis could harm millions of people. She discovered that facial recognition technology doesn't see dark-skinned faces accurately. Buolamwini, discusses further that facial-analysis software for commercial artificial intelligence systems, shows error rate of 0.8 percent for light-skinned men, 34.7 percent for dark-skinned women. The findings raise questions about how today's neural networks, which learn to perform computational tasks by looking for patterns in huge data sets, are trained and evaluated.
Follow this link to access to an example about how AI systems from leading companies have failed to correctly classify the faces of Oprah Winfrey, Michelle Obama, and Serena Williams. Artificial Intelligence Has a Racial and Gender Bias Problem | TIME (2024-09-12).

Examples of facial recognition programs have also shown that men are more easily recognized than women, and that non-white individuals are not easy to recognize. An example of the level of reliability in facial recognitions is shown below.



(source : The Gender Shades project revealed discrepancies in the classification accuracy of face recognition technologies for different skin tones and sexes. OCTOBER 24, 2020)

Another example about how Facial-recognition systems misidentified people of color more often than white people, is discussed in an article published by – The Washington Post. By Drew Harwell December 19, 2019, at 6:43 p.m. EST. The study shown effects of the use of officials' program iPads loaded with facial-recognition scanners at Dulles International Airport. (Bill O'Leary/The Washington Post) By Drew Harwell December 19, 2019 at 6:43 p.m. EST.

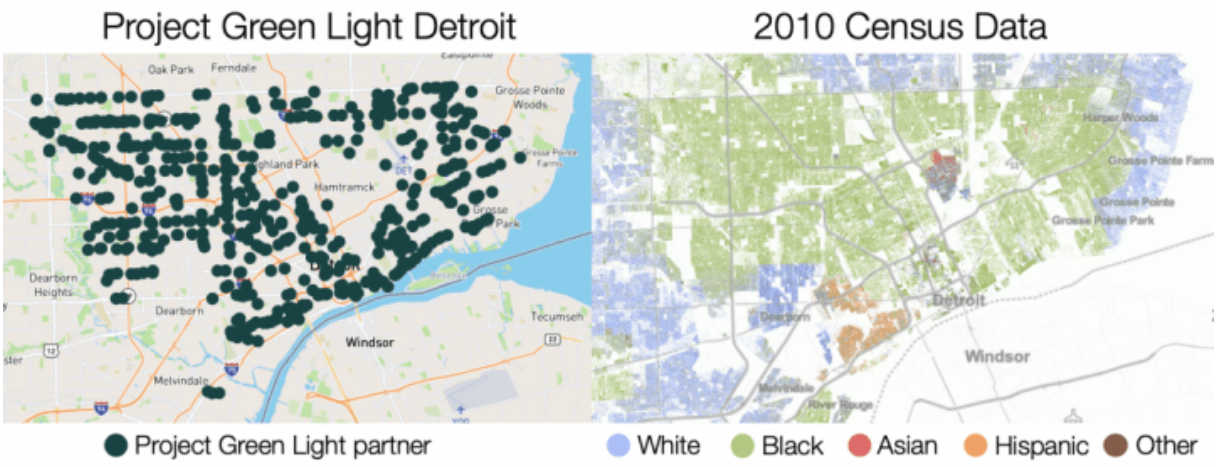


The article discussed that Asian and African American people were up to 100 times more likely to be misidentified than white men, depending on the algorithm and type of search. Native Americans had the highest false-positive rate of all ethnicities. The study discusses further that the faces of African American women were more often falsely identified than men, that elderly and children were more likely to be misidentified that those in other age groups and that middle-aged white men generally benefited from highest accuracy rates.

D.1 More examples can be found at:

- Buolamwini J. The Algorithmic Justice League to advocate for more humane uses of technology. (8 Must-Watch Movies for Leaders in 2020 | Inc.com. The film highlights the stories of people who have been impacted by harmful technology and shows pioneering women sounding the alarm about the threats artificial intelligence poses to civil rights.). (2024-09-12).

- An article published in USA TODAY, 2014 about Racial gap in U.S. arrest rates: 'Staggering disparity'. The article shown that "Black Americans are more likely to be arrested and incarcerated for minor crimes than White Americans. Black people are, consequently, overrepresented in mugshot data, which face recognition uses to make predictions. The article is available at: Racial bias in the application of face recognition technology. Locations of Project Green Light Detroit partners (left) overlap with primarily Black communities in data from the U.S. census (right). In this city-wide program, the brunt of the surveillance falls on Detroit's Black residents. (2024-09-12).



- Follow the discussion about a documentary on artificial intelligence, entitled Coded Bias delves into MIT Media Lab researcher Joy Buolamwini's .

- Follow this link to access to : Artificial Intelligence Has a Racial and Gender Bias Problem | TIME(2024-09-12).

E. Making machines talk: Speech synthesis

Gender assumptions can influence both the act of speaking and the act of listening (or interpreting what is heard) even when the speaker is a machine. Voices encode rich information about the speaker- such as gender, age and often nationality- even if such information is never directly articulated. Analyzing gender (socio-cultural factors), and sex (biological factors) is important for creating and synthetizing gender in TTS systems with a range of voices for assistive technologies and other human/computer interface. (Nass,C; Brave.S., 2005).

E.1 Examples of speech synthesis and gender can be found at the following links

• Videos (bing.com)
• More about Gendered innovation in Sweden available at the following link: Gender | Gendered Innovations | Sweden

4.3.2 Issues to consider when developing examples, training and teaching materials.

Teachers need to deal with many issues when developing training materials such as examples, exercises and/or exam questions. Example of questions that can be asked when reviewing teaching and training materials are:

- Are the materials used by the teacher or students free from gender stereotypes?
- Do the materials show females and males an equal number of times?
- Do the materials show females and males with equal respect and potential (when talking about jobs, or the future, for example)?
- Does the curriculum reflect the needs and life experiences of both males and females?
- Does the curriculum promote peace and equality for males and females, regardless of their race, class, disability, religion, sexual preference, or ethnic background?
- Are gender norms (social attitudes about what behavior, preference, product or knowledge influence the development of technology) considered in the examples or in the literature?

- Do the examples show any consideration to Gender identity (How individuals present themselves, and how they are perceived by others (Schiebinger,2021)
- Do the examples gendered metaphors that reinforce stereotypes?
- Are the language and images being used gender inclusive?
- Use the examples intersectional datasets?
- Are the themes, subjects, and pictures used in class materials connected to the life experiences of both female and male students?
- Are the examples socially relevant?
- How different groups of potential consumers (e.g., non-binary individuals, women, or men, old or young, etc.) are represented?

4.4 Stereotypes in the STEM areas

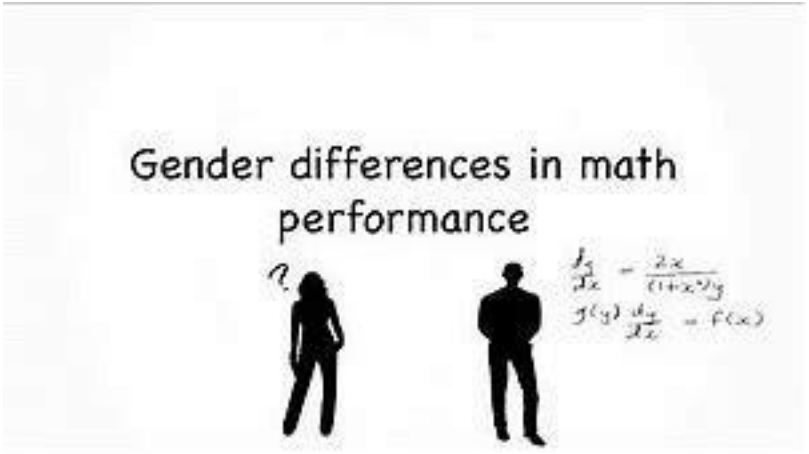
Stereotyping is a process of categorizing people into groups based on their characteristics, behaviors, or beliefs. Stereotyping can lead to prejudice, discrimination, and unequal treatment of individuals based on their membership in a particular group. Stereotyping can also reinforce negative attitudes and beliefs about certain groups, leading to further discrimination and marginalization.

The lack of diversity when developing examples is one of the main reasons why stereotyping continues to be a problem. When there is a lack of representation of different groups of people , it becomes easier to perpetuate stereotypes. For example, the lack of representation of LGBTQ+ individuals in media have led to harmful stereotypes and discrimination (Stereotyping: Beyond the Screen: Media's Role in Reinforcing Stereotypes – FasterCapital).

Many individuals still associate STEM fields with masculine qualities, leading to stereotypes that can discourage girls and women and non-binary and gender non-conforming people from pursuing STEM education and careers.

4.4.1 Some examples:

- **Gender-math stereotypes**, for instance, are thought to be a threat for women's mathematical performance, however, the mechanism of gender stereotype affecting mathematics achievement is not clear. Follow the link http://sciencecases.lib.buffalo.edu/c..to access to a video that examines the available evidence in one area of perceived gender difference, math performance. The entire case study can be found on the National Center for Case Study Teaching in Science website.



Everyone Knows Girls Are Bad At Math, Right?! Part 4 (youtube.com)
Produced by : The National Center for Case Study Teaching in Science
@nationalcenterforcasestudy1162.

- **The Stereotypical Computer Scientist**: Gendered Media Representations as a Barrier to Inclusion for Women has been discussed in several research publications. See Cheryan, S., Plaut, V.C., Handron, C. et al. The Stereotypical Computer Scientist: Gendered Media Representations as a Barrier to Inclusion for Women. Sex Roles 69, 58–71 (2013). https://doi.org/10.1007/s11199-013-0296-x
  The author discussed the effects of changing stereotypes using the media and how they can influence women's interest in computer science.

- Anne Litwin, PhD, Author of the "New Rules for Women: Revolutionizing the Way Women Work Together", January 18, 2022. The Impact of Gender Stereotypes in Computer Science and Engineering | LinkedIn, argues that i) gender-interest stereotypes exist among a racially and socioeconomically diverse group of children and adolescents across multiple racial/ethnic and gender intersections, ii) stereotypes cause girls to have a lower sense of belonging, which mediates their lower interest in computer science activities. She also argues that" the real-world implications of gender disparities in computer science and engineering are numerous and contribute to many societal inequities, such as the existence of products and services that overlook and sometimes selectively harm women and children

- Occupational stereotypes refer to generalized beliefs and perceptions about specific job roles and the characteristics or skills associated with those roles. These stereotypes are often based on gender, race, age, or other demographic factors, and can shape individuals' career aspirations, opportunities, and job satisfaction. They also influence societal expectations and workplace practices. (What Is a Stereotype? Definition & Examples, Enlightio.com, 2024-08-22, 09:44 AM). For instance:

Surgeons: Often stereotyped as being very serious, meticulous, confident, and emotionally detached.

Librarians: Traditionally stereotyped as being quiet, introverted, or stern.

Police Officers: Commonly viewed as authoritative, tough, disciplined, and sometimes aggressive.

Nurses: Stereotyped as being caring, nurturing, and female, which ignores the fact that many men are nurses as well.

Teachers: Often perceived as being patient, nurturing, and always having a calm demeanor.

Computer Programmers: Often stereotyped as being introverted, nerdy, predominantly male, and having a

deep fascination with technology.

Construction Workers: Often seen as physically strong, tough, predominantly male, and uneducated, which is a stereotype that doesn't consider the skill, experience, and knowledge needed in construction work.

Artists: Commonly stereotyped as being eccentric, emotional, and unpredictable.

Lawyers: Often perceived as being argumentative, ambitious, and willing to bend the truth to win a case.

Chefs: Commonly stereotyped as being perfectionists, passionate, and hot-tempered, especially under pressure.

4.4.2 Links to pictures of occupational stereotypes

Engineering Pictures on Popular Engineering Books. 2024 08 22 . 09 49 AM.55 Stunning Engineering Pictures That Are A Treat To Watch(wonderfulengineering.com)

Nurses images of a nurse – Search Images (bing.com) 20240822 . 3.15 PM

Firefighter : Firefighter Wallpaper – Search Images (bing.com) 24 08 22 3.41PM

4.4.3 When illustrating and developing examples of potential areas of application of novel technology, it is important to consider:

- If there is a risk of stereotyping or offending potential consumers through the exterior design (e.g., imposing role models, avatars, different forms of sexism, or racism etc.)
- Is there a risk of excluding certain groups (e.g., the elderly, young, individuals with some disability) through the technology design?
- If dominant subgroups are portrayed in teaching and learning materials more frequently and more positively than are other groups.
- If the examples or teaching materials reflect a society's diversity and distribution
- If the examples represent the range of characteristics in a society in positive and inclusive ways. Students identify with characters who are like themselves (e.g., are the same gender, have the same physical, socio-economic or ethical characteristics); therefore, ensuring equal representation of all individuals in teaching and learning materials can help expose children to positive messages and provide powerful role models.
- If certain configurations reinforce existing social roles (e.g., gender segregation in the workforce; men associated with engineering and women with domestic technologies, for example).

4.5 Bias in AI

Bias in AI can be introduced at any stage of its development, from design and modelling decisions to data collection, processing, and the context of deployment. These biases generally fall into the following categories (Unesco, IRCAI, 2024):

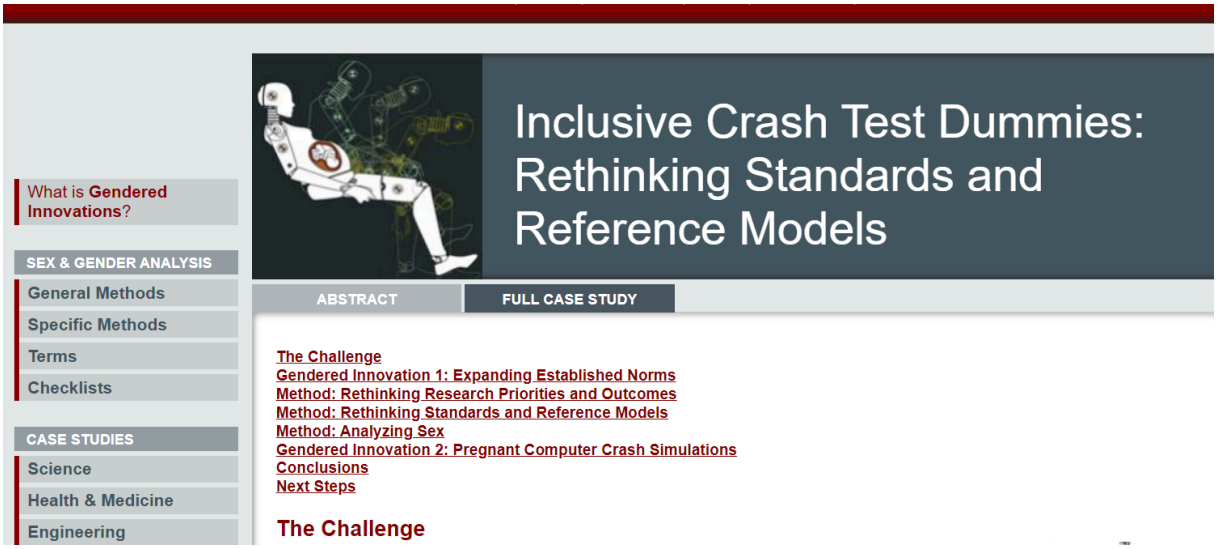
1. Biases in Data: Occurs during the selection or collection of features. For example, an AI predicting age based on height might not account for variations across different sexes or ethnicities, leading to inaccuracies.

2. Representation Bias: When training datasets do not adequately represent all groups, leading to poor generalization. An example includes a classification system failing for under-served populations like Hispanic female patients. (Seyyed-Kalantari et al., 2021)
3. Aggregation Bias: Using a “one-size-fits-all” model that fails to account for the diversity within the data. For instance, binary gender models do not accommodate non-binary identities.
4. Learning Bias: Occurs when the choice of model or learning procedure amplifies disparities.
5. Deployment Bias: Happens when AI systems are applied in contexts different from their development context, leading to inappropriate outcomes.
6. Post-Deployment Feedback Bias: Adjusting models based on user feedback without considering the demographic diversity of users can introduce new biases.

4.5.1 Examples of sources of bias

4.5.1.1 Standards and reference models in Crash tests

Women sustain more severe injuries than men in comparable crashes. Male body is however, often defined as the norm and serves as the primary object of study and as a reference model. Read the whole article at : Inclusive Crash Test Dummies: Analyzing Reference Models | Gendered Innovations (stanford.edu) 2024 08 22; 4 PM.



4.5.1.2 STAM cells research

Examples of the importance of gender were developed to explain the importance of biological sex and diversity and to illustrate gender differences in COVID 19-risk.Ya'qoub L, Elgendy IY, Pepine CJ, 2021 discussed in the article entitled Sex and gender differences in COVID-19: More to be learned! – Abstract – Europe PMC, that national and international governmental data have shown important sex and gender differences in the incidence and outcomes of patients with COVID-19.

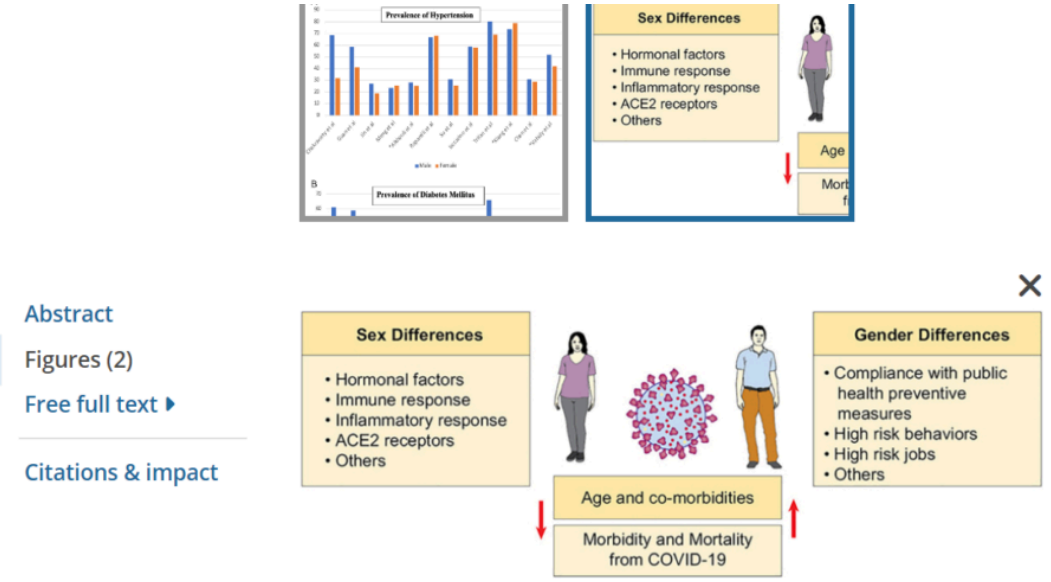


Fig. 2

Summary of potential factors influencing sex- and gender-specific outcomes in COVID-19 infections.

These differences are further not only attributed to the differences in age and comorbid conditions but likely a combination of factors, including hormonal differences.

Read the whole article at: (Ya'qoub L, Elgendy IY, Pepine CJ, 2021). You can access the publication at the following link: Sex and gender differences in COVID-19: More to be learned!
Sex and gender differences in COVID-19: More to be learned! – Abstract – Europe PMC 24 08 22 , PM

4.5.1.3 Mobility and transportation

Mobility patterns tend to be gendered in terms of where, when, and why people take trips. Transportation planning—both for modes and infrastructures—often do not consider diverse users' needs. For example, the need for safety can restrict mobility for specific women, gender nonconforming individuals, and the elderly. The European Mobility Atlas, 2021, discusses that mobility is not gender neutral. Social stereotypes and role distribution within a predominantly male workforce, (only 22 percent of all employees in the transport sector are female) create an environment that is aligned with male needs. (Diehl, Cerny 2021).

Understanding gender-specific needs across populations and capturing relevant functionalities, i.e. vehicle features and routes; and technologies used to access services (card vs bike), can help decision makers to capture differences in transport patterns or preferences for male and females and consider these issues when making socially relevant decisions.

Follow this link to access to the "European Mobility Atlas 2021 | Heinrich Böll Stiftung | Brussels office –

European Union (boell.org). Here you can also find illustrations about Women on the Move: Sustainable Mobility and Gender | Heinrich Böll Stiftung | Brussels office – European Union (boell.org) 24 08 22; 4 PM.

4.5.2 Ways to overcome gender stereotyping in your examples:

- Include diverse voices and perspectives
- Challenge stereotypes when you hear them
- Talk about stereotypes in your area
- Provide a range of role models
- Look at who uses which spaces and equipment
- Make sure there are not female and /or male tasks, examples
- Use an inclusive language

4.6 How to consider intersectionality when gender is not an obvious component

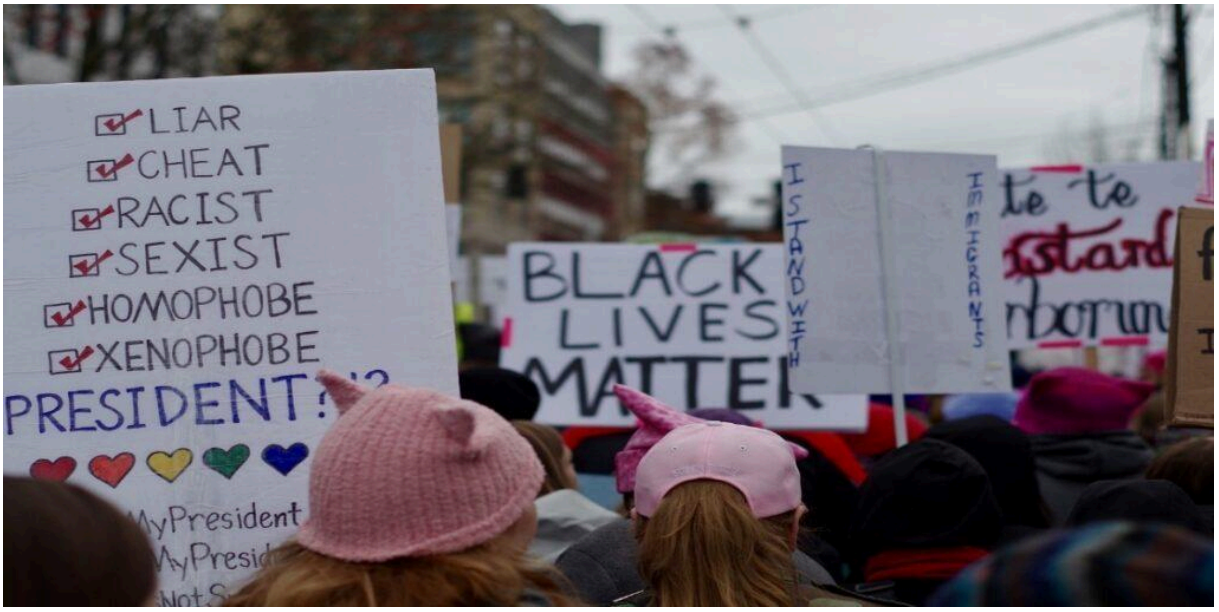


Image: Intersectionality & Intersection – Pixabay

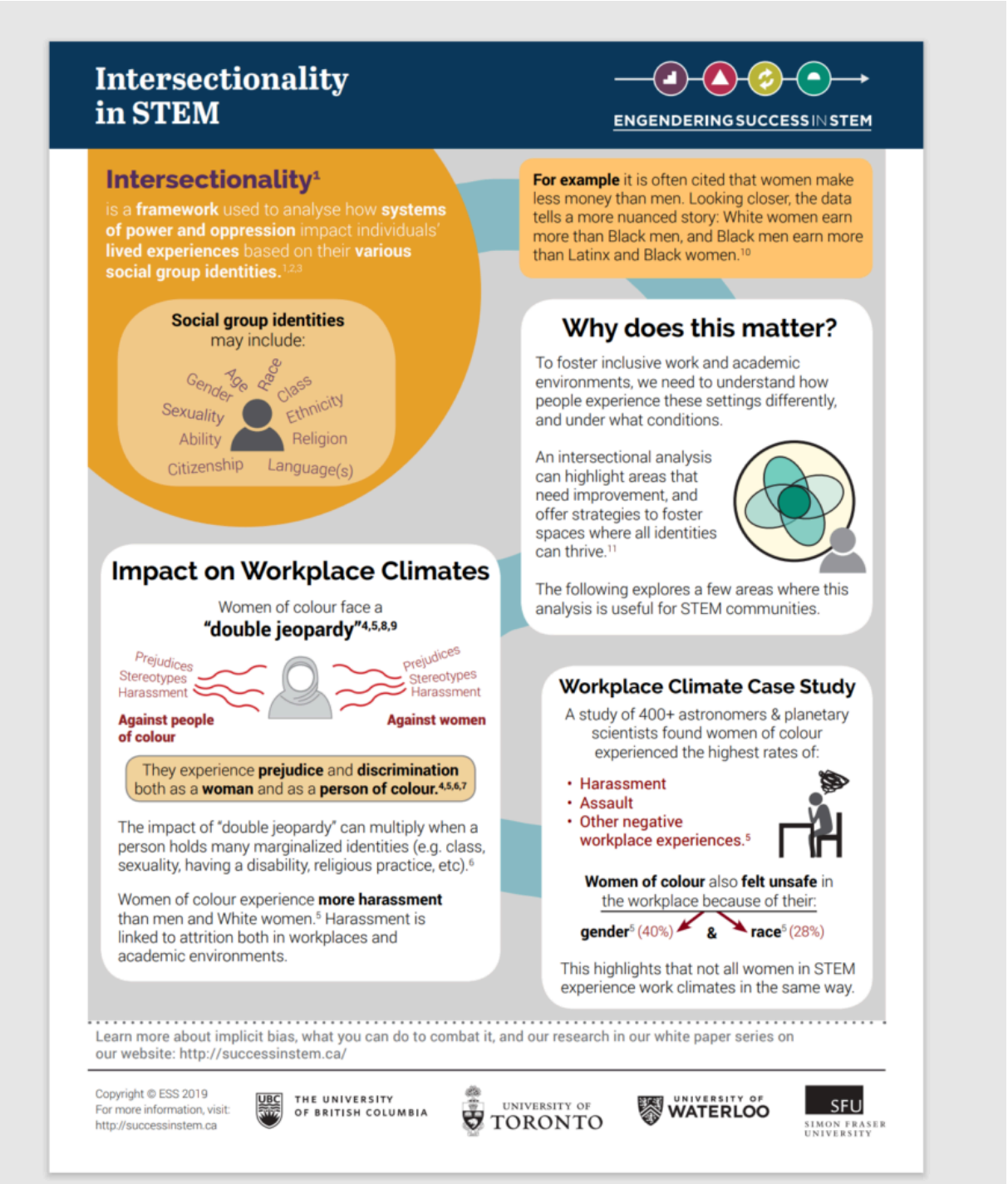
Intersectionality in STEM refers to the recognition that **multiple dimensions of identity (such as gender, race, sexual orientation, and socioeconomic background) intersect and compound disadvantages**(Intersectionality-in-STEM-Final.pdf (successinstem.ca))

4.6.1 Diminishing gender bias and stimulating intersectionality when gender is not an obvious component presupposes to consider:

- Socio-cultural relationships of society or groups are included in the examples.
- The stories, case studies, and examples should include women and men as active participants in roughly equal numbers in any activity.
- Pictures and other images must show women and men doing a wide range of activities, and not confining to gender stereotypes.
- The adjectives used to characterize male and female roles and behaviors should be positive and interchangeably used.
- The teaching and learning material must be inclusive of the various groups of society along linguistic, political, religious, gender, disabilities criteria, among others.
- Women and men must be equally portrayed as school principals, managers, drivers, doctors, engineers, and other non-traditional jobs
- The material must be free from gender-biased names such as “chairman,” “waitress,” “hostess,” etc.
- Make time to get feedback from both women and men to ensure that both genders have understood the lesson.
- Be open to feedback about your teaching methods and style, and do not pass any negative comments against students.
- Prevent master suppression techniques between and within students, peers, colleagues, course assistants, others.
- Call on or address both female and male a balanced number of times
- Distribute questions between male and female
- Explain the consequences of developing examples in which data collected is disaggregated by sec, gender, age , or socio-economic groups.

4.6.2 Where can I learn more?

- Read more about implicit bias, what you can do to combat it, in a white paper series produced by. The University of British Columbia, University of Toronto, University of Waterloo and SFU, on the following website: http://successinstem.ca. (see below).



- Read more about Gender Inclusivity Practices at Gender Inclusivity Practices | Teaching Commons (stanford.edu)

A poster titled "Gender inclusivity in the classroom: Quick tips and best practices"

Back to Top

Link to the report on: [Gender Inclusivity Practices | Teaching Commons (stanford.edu)]

4.7 Questions to discuss with your colleagues:ading Text Here

Questions to be discussed:

- What obstacles do you find when developing your examples?
- How can you recognize gender bias in your teaching material
- How you can prevent gender bias in everyday teaching
- How to embed gender, equality, and intersectionality in your teaching material even in areas in which gender is not an obvious parameter.

- How to embed gender in examples in which gender is not given,
- Can you consider an intersectional perspective in your examples?

1. The term intersectionality was coined by Kimberlé Crenshaw, 1989 “Demarginalizing the Intersection of Race and Sex: A Black Feminist Critique of Antidiscrimination Doctrine, Feminist Theory, and Antiracist Politics.” The concept of intersectionality has since been broadened beyond its initial framework of race and gender. It now includes a wide spectrum of social classifications, such as socioeconomic class, sexual orientation, age, physical or intellectual disabilities, and other dimensions of individual identity. Intersectionality emphasizes that different dimensions of identity are not isolated from one another; instead, they intertwine and overlap in intricate ways, resulting in distinct advantages or disadvantages, benefits or harms.

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5 STEM AS VIABLE CAREER OPTION

Introduction

This module provides background information, statistics and literature review that is essential for trainees to understand the gender disparity in STEM fields and the reasons why tailor-made tools to support women and people of any gender identity (see 1.1 section of this guide) in these fields are necessary. Through this module, trainees will obtain techniques and tools that, as educators, can use to support students in exploring all STEM career options beyond the widely known ones. In addition, they will be introduced to role models to inspire students and educators on the possibilities that STEM offers. Finally, they will be introduced to the concept of ESTEAM and the career options it entails. ESTEAM is a multidisciplinary approach and presenting it here aims at inspiring educators to approach their own fields and their students' career perspectives in a more creative manner.

5.1 Outcome of the module

Trainees will find techniques and tools to use in supporting their students in their career exploration. Inspirational material in ESTEAM and the significance of role models and the importance of representation as not just role models are also provided here to be used as sources of inspiration for both educators and students. Educators will get an understanding on the how entrepreneurship is related to STEM and the Arts.

5.2 STEM careers challenges and opportunities

According to data from Eurostat, the European Union's statistics agency, there were more than 6.3 million female scientists and engineers in the EU in 2019, accounting for 41% of total employment in science and engineering1. However, only 34% of graduates in STEM (science, technology, engineering and mathematics) fields in the EU were women in 2022. This proportion varied widely across the EU Member States, ranging from 55% in Lithuania to 28% in Luxemburg1. The most common degree awarded to women in STEM in the EU was for management and administration3. Some of the factors that may discourage women from pursuing careers in STEM include lack of confidence, stereotypes and lack of role models4.

1. https://ec.europa.eu/eurostat/web/products-eurostat-news/-/edn-20210210-1

3. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Tertiary_education_statistics

4. https://knowhow.distrelec.com/stem/women-in-stem-in-eu/

5.2.1 Skills STEM professionals acquire in the educational programmes

Engineering students expect that the skills taught in engineering courses will be the skills they will use in the field. Engineering degree programs largely ignore a variety of areas of expertise and skills that are required to be successful. Engineers need to be also good communicators, they need to be good managers, they need to be organized, and they need to understand the complexities of the relationship between the technical things they're working on and other social processes. A narrow math and science emphasis disproportionately disadvantage

women because it emphasizes male stereotyped skills while devaluing skills that are gender neutral or female-stereotyped, such as writing, communication, and managerial skills.

The skills will be used, trained and enhanced thanks to the STEM programs

Problem-solving

- Capacity to analyze a problem, design potential solutions identify effective implementation processes

Critical thinking

- Critical thinking is the ability to assess facts, conflicting theories or circumstances before making an informed judgement. By developing these skills, you can learn to make work decisions based on rationality rather than emotion, increasing the likelihood that they deliver success. For STEM careers, critical thinking skills could help you to create effective solutions to varied challenges, such as writing long-term investment strategies or creating safe and compliant civil engineering plans.

Creativity

- Ability to innovate and be able to see new ways of doing things. Creativity allows us to improve systems and make them more efficient and reliable. It leads to alternative pathways and inventions.
- Creativity involves using critical thought processes to create innovative solutions to new or existing problems. To think creatively, it is important that you are open-minded about untested ideas and can willingly experiment with alternative solutions. Though new ideas may not bring success on a regular basis, they may occasionally help you to reduce production costs or more effectively meet market demand.

Resilience

- Resilience is an ability to overcome disappointment, stress and self-doubt to secure career success. These successes may be either immediate or long-term in nature, ranging from completing a project on time to earning promotions. For STEM careers, resilience can help you retain faith in your ability to make effective decisions and deliver research breakthroughs even after past failures. If you remain upbeat under pressure, you can learn from past mistakes.

Data analysis

- Data analysis involves interpreting vast pools of statistical or factual data to identify trends. If they're relevant to the firm's commercial direction, you could then use these trends to inform future projects. For example, as a medical researcher, you can study patients' age, medical history and socioeconomic data to gauge different groups' susceptibility to certain illnesses. You may then propose new treatment options tailored to suit these groups' lifestyles or wealth, such as by developing cheaper or easier-to-prescribe drugs. If you could use data to clearly link phenomenons' cause and effect, you can help organisations to solve socio-economic problems.

Teamwork

- Teamwork skills allow you to closely collaborate with colleagues or clients, exchanging insights and providing practical support to meet project goals. By being an effective team player, you can more easily appreciate the emotional and financial interests of different stakeholders, before designing solutions that can balance these expectations.

This might help minimise staff turnover by reassuring colleagues that your organisation values their contribution at work. Examples of teamwork skills include conflict resolution, active listening and being reliable. By having these skills, you could build a more cooperative workplace culture as colleagues trust you to act in their best interests.

Openness to criticism

- Another key STEM skill is being open to criticism rethinking the problem and questioning from colleagues, clients and customers. Professional feedback can provide insights into how you may improve your own performance at work, meet targets more quickly or efficiently and increase revenue generation. By acknowledging feedback, you can find out which elements of your professional profile require improvement and notice personality flaws that you might otherwise overlook. You may then deploy this information to adapt existing work processes or output targets. Accepting feedback also proves that you value your counterparts' professional opinions, encouraging future cooperation.

IT skills

- You could also greatly benefit from developing IT skills, though the exact nature of these skills can vary based on your chosen STEM career. The term 'IT skills' covers proficiency in using various technology products, such as word processing apps, coding languages or asset trading software. You can take varied steps to develop IT skills. For example, if you're seeking employment as a stockbroker, you might either enroll on an asset trading course or use a free trading simulator. Contrastingly, to become an app developer, you might earn a computer science degree or enroll in a coding training course.

5.3 The significance of role models

Role models

Many girls lack access to role models who can inspire them to imagine all that they can achieve — from academic success to amazing careers. Role models and the representation of women, without necessarily being a role model, have a powerful and positive impact on girls, including their attitudes toward various careers, such as in STEM fields. Videos make it easy to bring these role models right to the girls you work with, engaging and empowering them to set and achieve academic and career goals and to believe in their ability to succeed.

- Example 1 – Software Engineer
- ELAINE ZHOU
- Link to the video: https://www.careergirls.org/role-models/software-engineer-1/

- Example 2 – Artificial Intelligence Engineer:
- AMY HEMMETER

- link to the video : https://www.careergirls.org/role-models/artificial-intelligence-engineer-amy-hemmeter/

- Example 3 – Maps and data operations manager
- KIMBERLY XIE
- link to the video : https://www.careergirls.org/role-models/data-operations-manager-kimberly-xie/

5.4 How to reduce gender disparity? Introduction to the concept of ESTEAM

- The term ESTEAM incorporates the fields of STEM with the field of Entrepreneurship and Arts to show the cross-disciplinary nature of these fields.
- The term STEAM is more commonly met in both non-academic and academic analysis and it refers to a teaching framework.
- Professor Georgette Yakman and her team put forward STEAM education (science, technology, engineering, art and
- mathematics) on the basis of STEM education, constructed the STEAM education framework, designed the STEAM teaching
- process card, and STEAM education training certification. STEAM education based on mathematics, engineering and art from
- the perspective of science and technology, interdisciplinary concept of different subjects will be integrated for the development of modern society to provide excellent human resources support.

The goal of the STEAM framework is to improve the students' innovative ability.
For STEM, the purpose is to focus on real-world learning through hands-on investigations and projects. Whereas in STEAM, it's more about the process. We're asking students to discover a problem through inquiry and then design a solution through creativity. This process leads to an end product which can then be refined based on feedback. Finally, in arts integration, we're focused on building connections across a variety of content areas to deepen learning and provide an opportunity for students to apply what they've learned in each content area in a new way.

At-A-Glance Comparison Chart

Institute for ARTS INTEGRATION and STEAM

Is it STEM, STEAM or Arts Integration? How is each approach related? Use this chart to guide your understanding.

	STEM	STEAM	ARTS INTEGRATION
Definition of the Approach	An **educational approach** which **intentionally** integrates science, technology, engineering, and mathematics to create **real-world learning** opportunities through **investigations**, **problem-solving**, and **evidence-based explanations**.	An **educational approach** to learning that uses Science, Technology, Engineering, the Arts and Mathematics as access points for guiding student **inquiry**, **dialogue**, and **critical thinking**.	An **approach** to teaching and learning through which content is **taught and assessed equitably** in and through the arts.
Use of Standards and Assessments	**Direct connection** to 2 or more STEM content standards. Both content areas are assessed within the lesson.	**Direct connection** to naturally-aligned content and arts standards. Both are assessed within the lesson.	**Direct connection** to naturally-aligned content and arts standards. Both are assessed within the lesson.
	Similar	Same	
Purpose for Using the Approach	**Integrates any STEM area** with another STEM area through naturally-aligned standards surrounding a point of inquiry.	**Integrates any STEM area with another arts area** through naturally-aligned standards surrounding a point of inquiry.	**Integrating the arts and any content area** with another content through naturally-aligned standards.
	Similar	Similar	
Foundational Support	Grounded in **inquiry**, **problem-solving** and **process-based learning**. The lesson is created intentionally to address these focus areas.	Grounded in **inquiry**, **problem-solving** and **process-based learning**. The lesson is created intentionally to address these focus areas.	Grounded in **aligned standards and assessment** through a central topic. The lesson addresses the standards within the context of the topic.
	Same	Different	
Intention and Focus	STEM focuses on developing **higher level thinking skills** by connecting classroom learning to the real world through **hands-on investigations**.	STEAM is **process-driven** through inquiry, design and creativity. The process leads to the product through a **discovery focus.**	Arts integration **deepens** learning, application and creativity through a **connective focus**.
	Different	Different	
How it Addresses Various Content Areas	**Addresses STEM areas explicitly**. Can utilize the literacy process and address the social sciences through the foundational lens of the approach.	**Addresses STEAM areas explicitly**. Can utilize the literacy process and address the social sciences through the foundational lens of the approach.	**Direct inclusion of all content areas**, including E/LA, Social Studies, Math, Science, Technology, Engineering and other Fine Arts areas.
	Similar	Different	

artsintegration.com

A table to assist educators in understanding STEM vs STEAM

The Institute for Arts Integration and STEAM provides more information here: https://artsintegration.com/2022/07/13/stem-vs-steam/

5.5 STEM vs STEAM

E-STEAM learning combines the principles of entrepreneurship with STEM disciplines and the Arts and fosters entrepreneurial competencies among students. Entrepreneurial context and STEM context share some common goals because both aim to develop students' problem-solving, critical thinking, and creativity. These competencies are not limited to STEM practitioners, but they are fundamental for entrepreneurs.

https://www.highereducationdigest.com/igniting-innovation-the-power-of-entrepreneurial-stem-learning-in-higher-education/#:~:text=In%20today's%20rapidly%20evolving%20world,STEM)%20learning%20into%20their%20curricula

5.6 Why is entrepreneurship in the context of STE(A)M important?

- By incorporating entrepreneurial practices into existing STEM curricula, new learning platforms will be created that encourage networkability, financial awareness and functionality. Students will develop important skills such the ability to identify and analyze challenges as well the ability to adapt to evolving situations. These are necessary skills for individuals to enter the workforce.
- There are numerous professional roles that can fit into the concept of ESTEAM and require a degree in STEM in combination with entrepreneurial and artistic skills or studies. The examples below illustrate what ESTEAM means in the real professional world.
- Video Game Developer: Game development is a multidisciplinary field that combines technology, mathematics (especially in coding and physics engines), and creativity in storytelling, character design, and visual art. Game developers often need entrepreneurial skills to market and distribute their games.
- Biomedical Illustrator: This role combines biology, technology, and art. Biomedical illustrators create visual representations of complex medical and scientific concepts, such as anatomical illustrations and medical diagrams. They use their artistic talents to make these concepts more accessible to a wide audience.
- Fashion Technologist: In the fashion industry, technologists merge technology and creativity. They work on innovations like smart textiles, wearable technology, and sustainable fashion practices, blending engineering and design principles with entrepreneurial skills to market and sell their creations.

Develop

1. Develop mentoring, to provide one-on-one career advice and role models to show the path, as well as the destination.
2. Develop and sustain interest in STEM education and careers.
3. Combating stereotypes threat e.g, women aren't good at math
4. Community building, combining all the above ideas, adding institutional commitment and support for building capacity.
5. Measure the achievements of specific goals.

5.7 Cultivate a sense of belonging

Female students often report that they don't feel as if they belong in engineering and computing fields. By emphasizing the wide variety of expertise necessary to be a successful engineer or computing professional—including less stereotypically masculine skills such as writing, communicating, engineering and computing programs can help young women see engineering and computing as fields in which they belong.

Universities in general and departments and board of educations in particular could:

- Develop career-based scenarios and description of the utility of the educational programs to enhance students' interest in science and their understanding of STEM careers by presenting them with authentic and engaging problems that are related to real-world STEM professions.
- Develop networks and stimulate teachers, industry representatives and administrative staff to become mentors for the students.
- Inform the students about professional associations and stimulate students to become members so that they can start building and belonging to networks.
- Arrange study days with focus on equality and gender and explain the value of becoming engineers for society, and for women.
- Engage teachers in the development of mentorship programs and encourage students to meet experts, distinguish researchers and managers to get an accurate picture of the areas, the academic value, and the importance of the STEM areas for research and innovation.

Who can be a mentor: A professor, an industry expert, a professional in a field of interest for the student, from any race or ethnicity.

A mentor is a person with experience, knowledge and connections who can help advance the career of another, usually more junior person (1)
There are different types of mentors (2):

- Peer mentors: professional colleagues who offer advice.
- Career mentors: tend to be in a higher position than their mentees and serve as career advocates and guides.
- Life mentors: usually at the senior stages of a career and may work within or outside of the mentee's current company.

(1) https://www.thebalancemoney.com/a-guide-to-understanding-the-role-of-a-mentor-2275318
(2) https://www.indeed.com/career-advice/career-development/what-is-a-mentor

5.8 Why is mentorship important for female students?

It helps women learn and grow from the experience of other women who have faced similar challenges and opportunities in their careers.
Provide women with valuable feedback, guidance, support, and encouragement to achieve their goals and overcome obstacles.
It empowers women to become leaders and role models in their organizations and

industries. Mentoring can help women develop leadership skills, gain self-confidence, and expand their network and influence.
It addresses the gender gap and inequality that still exist in the workplace. It addresses the gender gap and inequality that still exist in the workplace. Women are less likely to find a mentor and move up without the help of other women (1). Mentoring can help women overcome barriers and advocate for themselves and others.
It creates a culture of diversity, inclusion, and collaboration in the workplace.
Mentoring can foster a sense of belonging, trust, and respect among women and between women and men. Mentoring can also promote cross-cultural understanding and awareness, as well as innovation and creativity. Mentoring can help create a positive and productive work environment for everyone.

(1) https://www.mentorcliq.com/blog/women-mentoring-wo

5.9 Tips and tools for mentors

1. Choose mentees carefully: Although the prospect of having an energetic and personable junior partner for a multitude of projects is appealing, the wrong mentee can be painful That is why an initial conversation with your prospective mentee is a great way to start for both mentors and mentees to make sure both parties are on the same page and everyone knows what is expected from them.
2. Establish a mentorship team. The exclusive one-on-one relationship of mentor and mentee, long the norm, has been replaced by sharing responsibility with others for the growth of a mentee.
3. Run a tight ship. Establishing firm and clear ground rules with mentees can improve efficiency.
4. Head off rifts or resolve them. Mentor-mentee rifts are common in both business and academia, and they often aren't dealt with as quickly as they should be.
5. Don't commit mentorship malpractice. It's easy for mentors to wield their power inappropriately – even if they're not fully aware of it.
6. Prepare for the transition. A mentor's accumulated wisdom and expertise must be passed on to the next generation

Questions to be discussed

1. How to communicate the Importance of STEM knowledge today's society in everyday teaching and everyday students' activities?
2. How to describe and embed the value of STEM educational programmes?
3. The importance of cultivating a sense of belonging?
4. How can I support more girls/ women pursuing STEM studies and careers?

Tools & Questions to ask yourself and your students

- What does an aerospace engineer, for example, do?
- What skills are needed?
- What is the pay?

- What is the career outlook?
- Select the STEM cluster you prefer and investigate the career about which you want to teach your students.
- Ex. Aerospace engineer (link: https://www.careergirls.org/careers/aerospace-engineer/

Tools for a mentor:

- The GROW Model https://www.coachingcultureatwork.com/the-grow-model/
- GROW provides a framework for a coaching session, a conversation, a meeting or a project and is the best-known coaching model in the world today.

Other tools for career-consulting

- For an exercise use the Cool Career Facts to ask your student to remember the surprising and fun facts about the widely diverse careers. Help your students notice cool facts that might spark a student's interest. What makes a career stand out? (link – Page 29: https://www.careergirls.org/wp-content/uploads/2020/10/Teachers-Toolkit-Career-Girls-Guide-Oct-2020.pdf

E-STEAM References:

- Article: Igniting Innovation: The Power of Entrepreneurial-STEM Learning in Higher Education,Dr. Marwa Eltanahy, Lecturer, Higher Colleges of Technology,May 25, 2023,
-
- https://www.highereducationdigest.com/igniting-innovation-the-power-of-entrepreneurial-stem-learning-in-higher-education/#:~:text=In%20today's%20rapidly%20evolving%20world,STEM)%20learning%20into%20their%20curricula
- STEM vs. STEAM vs. Arts Integration:A Comparison Guide for Educators
- https://artsintegration.com/2022/07/13/stem-vs-steam/
- Other resources:
- A teacher's guide
- e-STEAM-ed Individuals: The significance of Art in STE(A)M,Kristen Feigel, Illinois Math and Science Academy
- https://digitalcommons.imsa.edu/rl_cpg_4/15/

6 SUMMARY AND EVALUATION OF THE COURSE KNOWLEDGE BANK AND FAQ

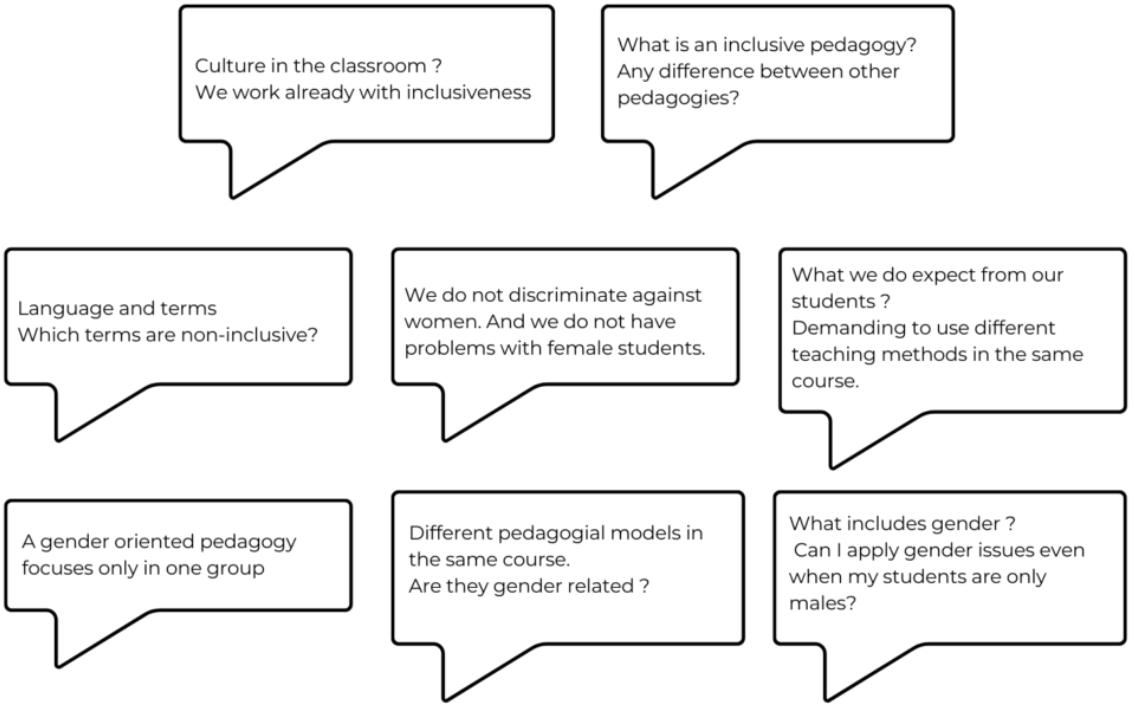
Summary and evaluation

- Evaluation of the training tool
- Voices from the teachers
- Suggestions and recommendations

TEST

- Test your knowledge
    - How much do you know about gender issues…?

How to be aware you are biased?



Some misconceptions

What is equality and equity

Fennema (1995) describes three aspects of equality:

- equal opportunity
- equal treatment
- equal outcomes

Equal Opportunity

- Access
- Removing external barriers such as streaming, setting policies & timetable structures
- Provide equal resources such as computers and calculators

Equal Treatment

- Teachers interaction with girls vs. boys
- Girls excluded from discussion
- Gender stereotyped scenarios, materials , and problems
- Textbook stereotyping
- A study by Boaler (1997b, 2002) found that particular teaching approaches have different effects on the attitudes and performance of girls and boys.

Equal Outcomes

- The pursuit of equity also involves a commitment to 'closing the gap' in outcomes, whereby outcomes include mathematical achievement, participation, retention and attitudes

Equitable Practice

- Equal access and equal treatment are not sufficient to overcome gender gaps and social injustices in schooling. A variety of approaches are needed to meet the needs of learners; one single approach won't do.

Theories of Gender, Equity and Practice

PARADIGM BEFORE 1975

- Deficit Theory: When it comes to mathematics, women are less capable, less interested and less skilled than males.
- Gender Stereotyping: Mathematics is the domain of males.
- Traditional: Little awareness and attention is paid to gender differences.

PRACTICE PARADIGM 1975-1980s

- Liberal Stereotyping: Given an equitable learning environment, women can be the mathematical equals of men and are capable of developing talent, skills and interest.
- Intervention Programs:
  DEFICIT
  THEORY
  INTERVENTION
  PROGRAMS

LIBERAL
PROGRESSIVE

- Single-sex classrooms and programs to isolate the sexes
- Focusing on specific mathematical skills and knowledge in teaching girls (ie. spatial domain)
- Increasingly equal treatment of the sexes in co-educational classrooms

PRACTICE PARADIGM 1980-1990s

- Difference Theory: When it comes to mathematics, women just have different skills, interests and experiences as compared to males
- Radical Feminist: The female experience and knowledge of mathematics should be valued and more positively and consistently addressed
- Gender-Inclusive: The curriculum and classroom practice is altered to include things females are interested in and good at, to encourage the building of their mathematical strengths

PRACTICE PARADIGM 1990-2000s

- Gender Construction: Societal interactions construct gender identities and dictate the distribution of power across genders. Different cultures and situations result in different constructs.
- Post-Modern: Gender is arbitrary and not fixed and is learned through society. There are differences amongst men and amongst women.
- Gender-Sensitive: A more student-centered classroom is driven by the interests and needs of the learners

Gender Sensitive Curriculum

- Researchers have identified mathematics as having multiple masculinities and femininities.
- It has been observed that the boys have usually dominated the classroom and were supported by the practices of the teacher.
- What effect does the use of computers in math classrooms have on gender gap?
- Teachers would observe boys' interest and success with computers as an achievement in mathematics.
- The behaviour of the dominant males (boys,men, masculine individuals) in such classrooms would interfere with the others' learning environment
- Girls in a "no-win" situation?
- The question – answer feedback method of teaching which is most common in traditional classrooms is advantageous to the male population.
- AND...even if girls succeed, their success is taken to be achieved in the wrong way.

Gender Equity in Practice

- To create an equitable learning environment, teachers must :
  – Use various teaching approaches
  – Be explicit about the mathematical concepts to be learned
  – Ensure that both males and females are supported and valued
- Goodell and Parker list 12 practices for teachers and curriculum designers to follow to create a connected equitable mathematics classroom (CEMC):
  - All students have access to academically challenging mathematics curricula.
  - Students are encouraged to develop confidence in their mathematics ability and positive attitudes toward mathematics.
  - Basic skills are developed that will enable students to be mathematically literate in the world outside of school.
  - The learning environment encourages students to develop their own voice and construct their own knowledge.
  - Teachers have high expectations of ALL their students.
  - Teachers connect mathematics with the real world.
  - Teachers are able to recognize and act on inequalities in their classrooms.
  - Teachers use a variety of teaching and assessment practices.
  - The curriculum is designed within a social and cultural context, challenges stereotypes and values the contributions of women and minority groups.
  - The curriculum includes real-world problems.
  - The curriculum includes a focus on issues of social justice and world problems.
  - The curriculum explicitly states equity goals.

Intervention Programs

- Socialization is main cause of female mathematical deficiencies
- Gender-Stereotyped patterns of play
- Gender Stereotyping of roles and careers
- Lack of opportunity in classroom

Some instructions
Link to the modules
Start of the course: list of modules and it contains on the left

- From the bottom xxxx you can click forward and go through all the modules.
- Each module contains an important question for you as teaching staff.
- There is also a reference list at the end of online training tool

- if you want to go deeper into any issue please see the list of references at the end of the training program.
- Voices from the teachers and participants in the evaluation process are added at the end of the training program

Litterature

OBS we need to search for examples

- List of reference litterature used to develop the contain of the training- tool
- And list of actual publications
- Classified in different blocks
- Books, peer-reviewed articles, online publications, industrial publications etc.
- Kvinnliga resp. manliga lektorer inom STEM områden

Fokus

    - på matematik och teknik
    - Positive attitudes towards mathematics and science are mutually beneficial for student achievement: A latent profile analysis of TIMSS 2015 Berger, N.; Mackenzie, E.; Holmes, K. Gender&STEM202, 2021
    - Should I stay or should I go?: Studying changes in university students' biomedical career plans Harackiewicz, J.; Rosenzweig, E. Gender&STEM202, 2021
    - Perceived teacher support and its associations with math motivational beliefs: Exploring gender differences using three large U.S. datasets Dicke, A.L.; Rubach, C.; Lee, G.; Safavian, N.; Gao, Y.; Starr, C.R.; Eccles, J.S.; Simpkins, S. Gender&STEM202, 2021

- STEM: Technology/Ingenjörsutbildning fortfarande inte lika attraktivt för kvinnor som t.ex. biologi, geografi
    - Genusfrågor (genus/socialt kön som är egentligen baserat på normer och omvärldens förväntningar kring vad som anses vara manligt och kvinnligt) påverkar känsla av tillhörighet och inkludering
- Underrepresenterade grupper känner sig mindre inkluderade
- Positiv lärarattityd påverkar studenternas resultat
- Role models
- Gender Gap in Science, Technology, Engineering, and Mathematics (STEM): Current Knowledge, Implications for Practice, Policy, and Future Directions Educ Psychol Rev. 2017 Mar; 29(1): 119–140.
- Published online 2016 Jan 13. doi: 10.1007/s10648-015-9355-
- McKinnon, M., O'Connell, C. Perceptions of stereotypes applied to women who publicly communicate their STEM work. Humanit Soc Sci Commun 7, 160 (2020). https://doi.org/10.1057/s41599-020-00654-0

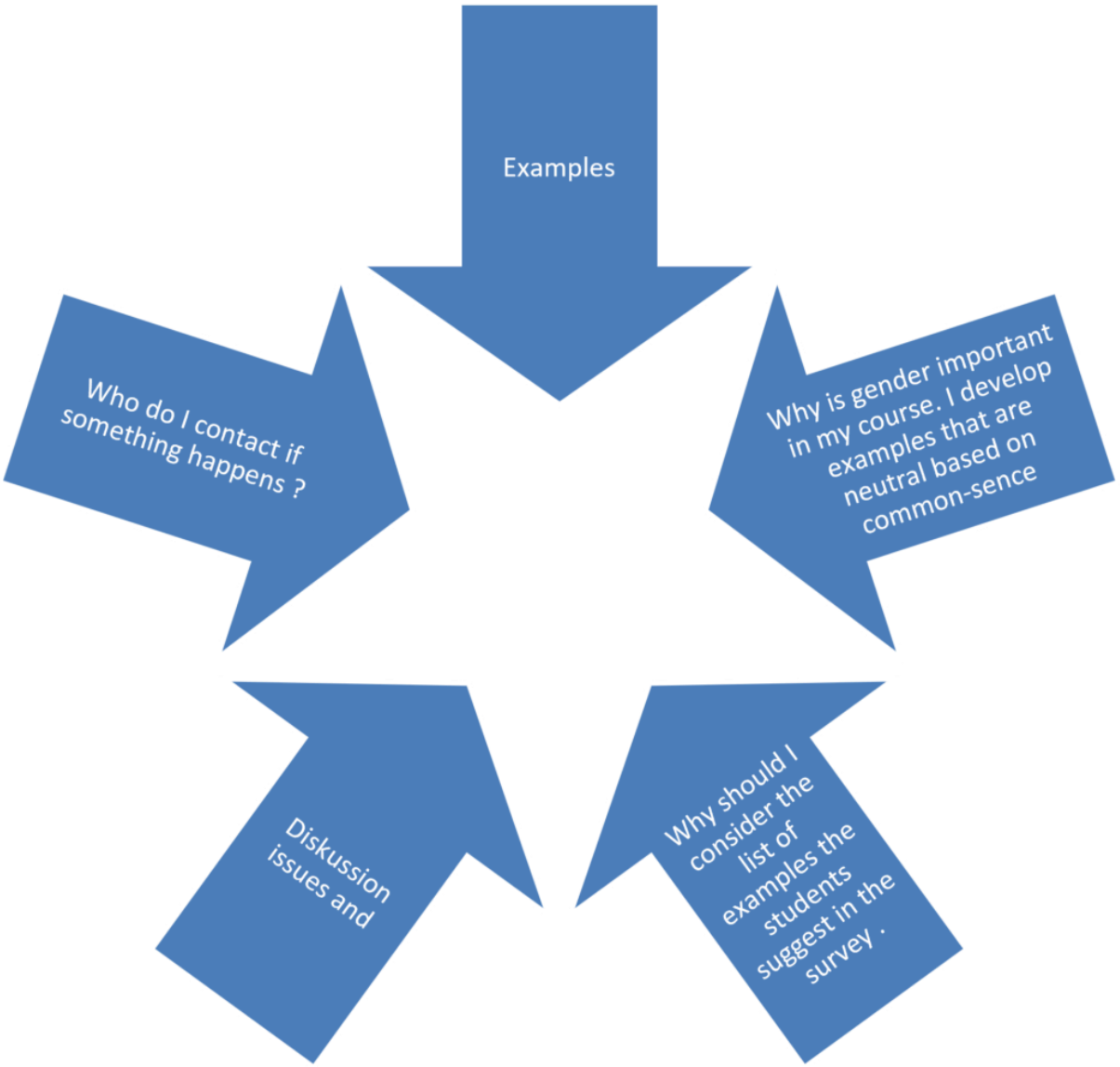
Gender integration

Chunyan Yang (2021) Online Teaching Self-Efficacy, Social–Emotional Learning (SEL) Competencies, and Compassion Fatigue Among Educators During the COVID-19 Pandemic, School Psychology

Yahaya, I.A, Chado. A.M , Adamu, Z.E (2021); Effects of Digital –Game and YouTube Instructional Package on the Achievement and Interest in Chemistry among Students in Bida, Niger State in International Journal of Research and Innovations in Applied Science(IJRIAS) 6(3) 81-87 10.1080/2372966X.2021.1903815

- **FAQ**

OBS we need to search for examples



An intersectional approach will be applied to all training modules to include other categories that are cross classified with gender including sex, class, race, nationality and religion. In this way, partners will ensure that diversity, equity and inclusion is a key element of the programme.