STEM Teacher Training Innovation for Gender Balance

TOOLKIT

This Teacher Professional Development programme provides teachers with tools to reflect on gender and the opportunity to change their practice to become more gender inclusive in their teaching.

STING

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The STING Statement

The STING project promotes the integration of gender into STEM education by providing Teacher Professional Development activities. Awareness of gender, and other forms of difference in teaching and learning practices is important to provide better outcomes, especially in Science, Technology, Engineering and Maths (STEM) education. Ultimately, our goal is for teachers to find inspiration in the STING activities and suggestions and will accordingly adapt and change their practice by taking gender into account in STEM teaching.

INTRODUCTION TO THE TOOLKIT

Purpose

The STING project promotes the integration of gender awareness into STEM education using a modular teacher professional development program. The program has been developed as a toolkit that teacher trainers and teachers can use to raise gender awareness in STEM teaching and learning, as well as to support other teachers to build gender awareness into their professional practice.

Careers in STEM continue to be male-dominated. While making great strides in areas such as the Biological Sciences, in general, women continue to be under-represented and marginalised in areas such as Chemistry, Engineering, Physics, and Computer Science. Whilst women have made significant progress, they are still in the minority in most STEM disciplines, and the proportion of women tends to decrease as seniority/tenure increases[1].

Despite the fact that numbers of males and females participating in, and excelling at, science are roughly equal throughout primary and secondary school, fewer women enter STEM majors in college, and fewer still graduate with a STEM degree. The pattern continues as lower percentages of women pursue advanced degrees in STEM areas and fewer yet obtain jobs in STEM areas[2].

1 *Hill, C., Corbett, C. and St. Rose, A. (2010). Why So Few? Women in Science, Technology, Engineering, and Mathematics. Retrieved from the AAUW* <link: https://www.aauw.org/files/2013/02/Why-So-Few-Women-in-Science-Technology-Engineering-and-Mathematics.pdf>

2 *McGill, C. M., and Woudenberg, D. L., (2012, June).Gender matters in STEM majors! Retrieved from the NACADA Clearinghouse of Academic Advising Resources Web site:* <link: http://www.nacada.ksu.edu/Resources/Clearinghouse/View-Articles/Gender-issues-in-STEM-majors.aspx>.

Training objectives

Our objectives are that teachers will:

- **Appreciate** the need to build gender into educational practice.
- **Know** that women are under-represented in STEM career subjects.
- **Raise** gender awareness in teaching and learning and subsequently influence classroom practice.
- **Build** gender considerations into professional practice.
- **Reflect** on the inclusive nature of their STEM teaching and learning.

The purpose of STING is not to enforce a strict gender code, but simply to make educators aware of the subtle influence of gender on classroom atmosphere, activity and learning preferences. Participants in STING activities should enjoy what they do and enjoy what they learn!

How to use the toolkit

The trainer should design the training as a comfortable place for teachers to share ideas, concerns, questions, together with successful and problematic practices. Best results are obtained by evenly mixing gender and science content, pedagogical content and teaching strategies. It works well to start the training with an icebreaker activity, followed by another activity to share self-expectations and align them with the aim of the training.

The toolkit therefore uses a two-step process. Firstly, choose activities from group one, which are designed to raise gender awareness. Secondly, choose activities from group two, which are designed to change classroom practice. The activities are flexible and trainers can tailor them to meet the individual needs of classroom teachers.

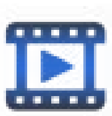
Useful icons:


Photo


Idea

Power point presentation


Worksheet


Video

link to a document

Group One Activities: Gender Awareness (Appreciate, Know, Raise)

These activities will stimulate teachers to challenge their gender bias and to integrate gender into classroom practice.

Group Two Activities: Classroom Practice (Build, Reflect)

These activities provide suggestions as to how teachers can adapt and change their practice by taking gender into account in STEM education.

Gender and sex

Gender should be distinguished from sex, which is the physical and biological differentiation of living organisms through various features and functions. Taking account of these differences is important, for example, in the shape of clothing or in the positioning of seatbelts in cars. Gender considerations arise when designers fail to accommodate the needs of both sexes equally. We can consider gender as a container for a set of characteristics, partly determined by individuals and partly by society.

Group One Activites

GENDER AWARENESS

Introduction: What is gender?

Participants will explore their own ideas, and those of others, regarding gender identities. We all have at least one gender identity, but how we express it, and how others interpret it, is sometimes misconstrued. This activity is designed to get participants thinking about gender.

Objective: Increase gender awareness in relation to identity.

Materials: None, although a flipchart or other recording device could be used.

Preparation: 30 minutes.

Duration: 30 minutes.

Description:

Two or more volunteers, preferably at least one male and one female, stand in front of the group. Participants make observations for each volunteer, of what establishes each of them as a gendered person. Participants have five minutes to share their observations, followed by five minutes in which they can ask the volunteers questions. In order to protect their personal privacy, the volunteers are free to invent answers. Participants spend the next five minutes (per volunteer) building a gender profile of each volunteer. The exercise is then repeated.

»Men's clothes can be worn by women, but not the other way round. Or not?«

The objective is to show that assumptions on the basis of observation may be misleading. In general, identity is more complex than 'who wears the trousers'. Although this exercise appears simple, it frequently creates heated debate!

Video Message

This activity aims to give teachers and trainers an opportunity to reflect on their own teaching practice and specifically to reflect on how they reach out to female and male students in the classroom. Four thought-provoking questions were put to four Danish experts on gender in science and these video interviews give food for thought and stimulate further discussion and reflection.

Objective: To confront teachers and trainers with research findings in order to inspire them to discuss how they relate to these findings.
To reflect on their own teaching practice on the basis of these discussions.
To provide a European context for gender and broaden such discussions on gender in the classroom.

Materials: Pens, post-it notes, flipchart, computer and projector, links to videos:

Video 1
Video 2
Video 3
Video 4

Preparation: Prepare the videos (some of these were developed in the TWIST project).
Participants are seated in small discussion groups around tables.
Pens and post-it notes are laid out on each table.

Duration: 60-90 minutes

Description:

Start the activity by introducing the researchers and commenting on their area of research. Four short video interviews are available for this activity on the STING website.

The videos ask the following questions:

1. What findings on differences between female and male students has your research produced?
2. It is claimed that the differences between the sexes are significantly smaller than those found within the sexes. What is your opinion on this?
3. Research indicates that female teachers regard poor performance by female students as caused by a lack of ability, whereas in male students it is seen as the result of a lack of effort. Is this true?
4. Do female and male students have different cognitive skills? Do female and male students learn differently?

Before watching each video interview, the participants are asked to consider their own individual answers to questions number 2, 3 and 4. They are asked to write these down on post-it notes. This is done to give each participant time to reflect on their own opinion before engaging in discussion with the others. This also offers an opportunity for reflection and helps to motivate participants to be more aware of – and curious about – what the researchers will say.

The video messages are then played (duration: 12 min.). Instead of showing the entire video you can stop after each posed question and have the groups reflect on only one question at a time. You might want to end this session by sharing the different reflections in plenary. It can be a good idea to have PowerPoint slides or large pieces of paper posted on the wall with the questions in order to focus the participants on the topic discussed.

After watching the videos, the participants can be given additional questions to

»This is a reflection exercise that gives teachers an opportunity to reflect on their own practice.«

discuss (this is optional). The following are suggestions for additional questions that can be posed one at a time for further discussion.

1. Do you recognize a tendency to have different expectations of male and female students?
2. Are researchers right when they claim that the biggest differences between female and male students are to be found in the teacher's head, not in real life?
3. Do you think it might be true that the differences between female and male students are not as significant as those found within each gender?
4. Do you find female or male students more interesting to teach?
5. Research says that we teach our female and male students to fit into our gender preconceptions. What kind of person do you teach your students to be?

After the groups have discussed two of the questions, participants can form new groups.

Gender and Technology: Am I responsible?

This activity opens up STEM topics in school to new ways of thinking about research and society. It aims to increase understanding of how STEM subjects, and STEM research, could be more inclusive, especially in relation to gender. The activity could be in any of the sciences, including earth sciences, biology, chemistry, or physics. Each participant should come with one activity in mind, prepared as a short description of the lesson, including some information on the scientific background.

Objective: To increase awareness of the gendered aspects of STEM educa tion, technology and research within the context of "responsible research and innovation".

Materials:
- Okada A. (2016) Responsible research and innovation in science education report. Retrieved from Milton Keynes: The Open University – UK. ISBN 9781473020191.
- STING: Preliminary thoughts and theoretical frameworks.
- Flipcharts & pens.

Preparation: Read the materials.

Duration: 60 minutes.

Description:

Think about a science or technology learning activity, either one of your own, or an activity from an online repository of STEM activities for teachers, such as:
- Mascil classroom material
- Inspiring Science
- Scientix

Think about the following questions:
- How does gender affect the content?
- Did male or female researchers develop the science content?
- Who is affected by research in this area and why might the effects on men and women be different?

The point of this activity is that, as with some of the other STING activities, gender bias is often hidden and requires reflection and debate in order to bring it to the surface. For example, one of the Mascil (mathematics and science for life) activities involves calculating the optimum layout of an underground car park. This provides opportunities to speculate on issues such as:

- How might it feel to be a woman or a man unloading her or his car at night in such a place?
- How safe is the car park for young children?
- Who designs car parks anyway (cf. the "Architect" activity below)?

The point of thinking about this in terms of responsibility is that, as a society, decisions should be made on the basis of wider and more inclusive participation in processes. This applies in school as well. The Irresistible project provides ideas about how student responsibility in STEM can be encouraged.

This includes researchers being responsible for taking gender considerations into account in decision-making about research topics and projects.

Architect Game

The participants will become more aware of their prejudices which might influence them to act differently in the future. This includes the connection between science and everyday life, identification of the role models and stereotypes that are promoted through education and/or daily life, as well as reflection on how adults interpret the scientists' profile.

Objective: Encourage the participants to experience their own prejudices.

- Realise the connection between science and everyday life.
- Have the opportunity to explore student perspectives on the identities of scientists, especially regarding gender.
- Realise how role models and stereotypes are being promoted through education and/or their daily lives.
- Reflect on how adults interpret the scientists' profiles.

Materials: The story, a pencil and paper for each participant.

Preparation: Each participant should have a table that they can draw on.

Duration: 15 minutes.

Description:

This activity is suitable for the classroom and with teachers. Participants are told a story about an architect (whose gender, age and race are not mentioned), and are then asked to draw the person they see in their mind's eye. The facilitator asks some of them to show their pictures and to explain what they depict. What are the specifics of this person? (Gender, race, wearing glasses, colour of hair, etc.…) Do you have any idea why this is your image of an architect?

Story

Close your eyes and imagine. An architect has thought all day about a new bridge that is to be built. Traffic, including big lorries, has to be able to cross a wide river. The architect does not only want the bridge to be large and safe, but also beautiful. After a long day of thinking, the architect has a great idea for the bridge. Think about how happy and enthusiastic the architect looks. The architect says, "This is going to be a great bridge!"

Assignment
Draw the architect.

Group discussion
Collect the drawings and hang them on a wall. Compare and discuss the drawings with the students.

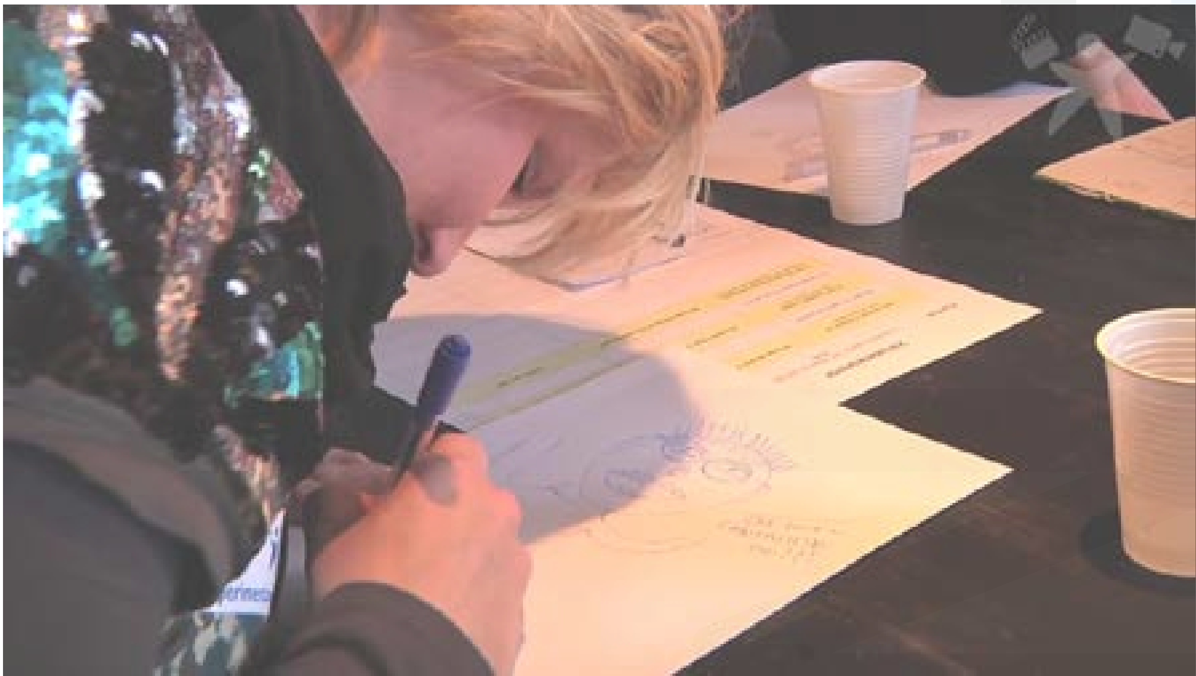
- Ask the students if their architect is male or female.
- How old are the architects?
- Are there other specifics about this person?
- What do you need to become a good architect?
- Have the students seen an architect on TV or in a magazine?
- What was that architect like?
- Is it possible that the image they have drawn corresponds with that person?

»It is also amazing what you see when you search "architect" in an image search engine.«

As a teacher professional development activity, you can ask the teachers to read the story in their class and bring with them drawings from their students. You can then spend some time identifying patterns in those drawings.

This activity may cause language problems. In Dutch, as in English, “architect” is not a masculine or a feminine word. Individuals are “free” to visualise either a male or a female architect.

If “architect” is a masculine or feminine word in your language, this story will not work, but you may be able to come up with a gender-neutral alternative that does.



Implicit Association Test (IAT)

In this activity, we examine the unconscious associations made by participants between gender and science & technology or humanities. The participants learn to understand and physically experience the difference between (unconscious) implicit associations and behaviour. The participants will also learn that having implicit associations does not necessarily mean acting stereotypically or agreeing with prevailing stereotypes. By playing the game, most participants discover in an informal way that they subconsciously harbour gender biases, which may inadvertently affect their behaviour.

Objective: The participants learn that everyone to a greater or lesser extent has implicit associations in science & technology or humanities and gender. The objective is for the participants to become aware of their implicit gender biases in order to reduce the impact of these biases on their behaviour and on their decision-making.

Materials: IAT document & Stopwatch.
Per participant:
Option 1: A computer per participant.
Option 2: 40 playing cards (or 4 lists) of the words in the IAT document; the exercises either on paper or in a digital document; four small signs on which are written:
- Humanities or Feminine.
- Science & Technology or Masculine.
- Humanities or Masculine.
- Science & Technology or Feminine.

Preparation: Arrange the room to enable holding a discussion and watching a short film.

"I am really going to start challenging my own pre-conceptions of what women or men can do."

Option 1: Prepare all the computers with the test
Option 2: Produce the signs & the lists (either in playing cards, on a poster or in a PowerPoint); every participant should have a chair, tables are only necessary with the card game version (so that each two participants will be able to stand on both sides facing each other); have the video ready to be shown.

Duration: 15 minutes.

Description:

1. Introduction:
The facilitator articulates that you cannot determine whether you have implicit associations and how strong they are, because they are implicit and arise unconsciously. But, with certain exercises, you can uncover these implicit associations. We are going to do an exercise where you are going to experience your implicit associations.

2. Getting to know your implicit biases
The activity is based on the IAT (Implicit Association Test) that measures the implicit opinions and beliefs that people do not want to, or cannot, reveal (in addition to gender, these can include race, weight, nationality, origin, skin colour and age). There are different ways to perform this activity - choose the one that fits your participants best.

a. OPTION 1: An online tool
With an online test you get to know your implicit biases:
- On the Harvard website.
- On the TWIST project site.

b. OPTION 2: A game
This version is a competitive game for two players. They sit facing one another. In front of each are a pile of cards and two signs.

The first player has the signs:
- Humanities or Feminine; and,
- Science & Technology or Masculine.

The second player has:
- Humanities or Masculine; and,
- Science & Technology or Feminine.

"I never realised that I had so strong gender biases. It has definitely given me something to think about."

Explain the assignment: You will see a list of words. Those words can be divided into two categories. The idea is that you divide the words into the appropriate category. Go through the lists of words. Is it clear to everyone which word belongs in which category?
Does anyone have questions? Point out at least the words geology, biology, ethics and philosophy, these words sometimes cause debate.

In any exercise the task is to *divide the words* in the list *as quickly as possible* in the right category, *without making mistakes*.

Each player sorts his or her cards into the two categories. They must do this as fast as possible, competing with one another. When they have finished, the players change places and repeat the exercise with the other signs. They then play the entire game at least two more times. After each "round" they check who has "won".

Please note!

- It is important to place the cards in advance in the correct order, so that one can immediately start playing after receiving the instructions.
- *Another way to play the card game is to use your body.* You can do this with a whole group instead of playing a game in pairs. Instead of sorting the cards, tap your right or left knee and use a poster (or PowerPoint slide) with the words on it.

3. Discussion afterwards:

At the end of the session, participants have a short discussion. It is important to point out that results can be affected by various external factors, such as distractions during the course of the game. In most cases the results are valid, but it is quite possible to obtain results that do not reflect the player's true attitudes. However, the game is designed to raise awareness of the issue, rather than as a diagnostic tool. The results should be viewed with a healthy dose of curiosity and scepticism.

Questions to be asked:

- What did you feel?
- Was there a noticeable difference between the different rounds? And was the level of difficulty the same in each case?
  - How come?
  - Did you expect that?
- Name the difference in time between the different rounds.
  - Why did one last longer than the other?
  - Did you expect that?

- Have you experienced a different attitude from teachers towards female and male students in class? How can this affect their success?
- Are there differences at home in the way parents encourage brothers or sisters to study science and technology?

Probably you felt more resistance in your body during either one of the rounds or perhaps you needed more time to think during the exercise. Because you needed to perform a motor activity (tap or sort, left or right) most attention goes to that. This means that dividing the words into categories will be done on autopilot as much as possible. And then it goes wrong more easily during the other round.

4. Showing a short video

Show a short animated film on the influence of our implicit biases on our decisions, opinions and choices, and on the importance of recognizing them and raising awareness of them. The film can be accompanied by subtitles and concludes with the claim that implicit biases cannot be prevented, but awareness of their existence can reduce their impact.

Questions to be asked:

- We spoke about the implicit biases we all have that can influence the choice by girls and women of professions in science and technology. ->Is it/why is it important for both groups to study and work in STEM areas?
- Culture is one of the main factors influencing the participation of women in the world of science and technology. One piece of evidence for this is the existence of cultures where both sexes are represented and succeed equally in professions. In the western world the participation of women in computer sci ences is particularly low, while in eastern cultures, in Eastern Europe, in South America and in Africa, women are represented equally in this profession (and sometimes their percentage share is higher than that of their male counter parts).

Who is the scientist?

The activity is designed to stimulate educators to consider their gender biases and whether they influence their teaching.

Objective: To tackle prejudice and show that we often judge people regarding their appearance and gender and from established social perspectives.

Materials: Photos

Preparation: Choosing and printing the photos. Setting up the photos. Hanging the rope and fastening photos on it.

Duration: 10-20 minutes

Description:

The activity is a good way to stimulate participants to think about their gender stereotypes and about gender balance in general. The facilitator of the conversation can introduce statistical data about women in science (local and world) into the conversation. The activity is also a good opportunity to discuss the theoretical background of gender balance. Our society often expects science to be a male occupation. When asking participants "which of the kids in the photographs became a scientist" they tend to pick the male candidates. By asking participants to explain their specific choice of person, they are forced to think about their decision and also to reflect on the reasons for their choices.
Discussion in small groups makes people more at ease to share their opinions and to express their existing gender biases.

»It reminded me of my stereotypes.«

»The activity opened my eyes about my personal stereotyping.«

Make a collage / Magazines

Make participants aware of their own biases and of the biases of the general public, so they can address them in their everyday lifes. The aim of this activity is to be thought-provocative.

Objective: To reveal some of the gender biases that participants see, hear and experience all the time.

Materials: Copies of typical girls' boys' and gender-neutral science magazines, sheets of A4 or A3 paper, scissors & glue, printed work sheets (one A4 per participant and one A3), computer with sound and screen, flipchart with markers.

Preparation: Take time to gather magazines and be critical about which magazine to use, some could be more interesting than others.
Option 1 (with students): Make groups of 2 to 4 participants per table and give them a variety of magazines (make sure to have a diversity of girl/boy/science/gender neutral magazines)
Option 2 (with teachers): Put all the magazines on two tables, each in opposite ends of the room, and leave them to choose.

Duration: 45 minutes

Description:

»Very interesting. The more the time there is for this, the more interesting are the answers.«

Tip - Some other resources could be useful too: textbooks, videogames, TV serials, advertisements, toy catalogues etc.

OPTION 1 (with students):

1. Introduction (2 min)

Tell the students that they are going to make a collage. They will be working in pairs or small groups. Tell them to go through the magazines, focusing on the pictures, photos and illustrations. Decide which pairs or groups will use which magazines. Ensure that there are at least two collages of cuttings from each category of magazine.Tell the students to make their collages. They can cut pictures, photos and illustrations from the magazines and paste them on to sheets of A4 or A3 paper.

2. Main part (25 min)

Give the groups 20 minutes (5 minutes for each kind of magazine) to go through the magazines on their table. Each group takes notes about what they see and what strikes them and subsequently make a collage based on their notes.

You culd have the students focus on:

- Pictures, photos and illustrations.
  What are the people portrayed doing?
  What is the mood of the people portrayed?
  What is the attitude of the people portrayed?
- Colours that are used.
- Other striking characteristics.

3. Reflection & conclusion (7 min)

a. Ask the groups to compare their collages.
   - Are there differences between them?
     In behaviour?
     In mood?
     In attitude?
     In use of colour?
     Other striking characteristics? For example, positive/negative features?
   - What are the differences?
   - Why are there differences?
   - Do the students think that this influences them?

b. Discuss this with the whole group.

OPTION 2 (with teachers):

1. Introduction (2 min)

Tell the participants what they are going to do:
Discuss the issues of bias and stereotypes within youth and children's magazines:

- Typical girls' magazines (according to the publisher).
- Typical boys' magazines (according to the publisher).
- Science magazines for the target group you're working with.
- Gender-neutral magazines.

    Work in small groups of 2 or 3 persons.
    Take one magazine of each category (girl/boy/science/gender neutral). Make sure at least one person of your group can read the magazines.
    Go through the magazines and focus on... (see worksheet).

2. Main part (25 min)

Give the groups 20 minutes (5 minutes for each kind of magazine) to go through the magazines on their table.
Each group takes notes on what they see and what strikes them, and makes a collage based on the notes. Use the worksheet to focus on:

3. Reflection (7 min)

Compare the notes and write them on the poster page.
Reverse the chart from the worksheet. Ask for a volunteer to write down the conclusions on the printed A3 worksheet.

- What are the differences of behaviour in the people portrayed?
- What are the differences of mood in the people portrayed?
- What are the differences of attitude in the people portrayed?
- Are there differences between the kind of magazines and the use of colours?
- Other differences? Are there others things that were striking? For example, positive features?

4. Summary

Summarise your reflections based on the identified differences (overleaf).
Discuss your reflections with the whole group.

Perception Quiz

The perception quiz will give participants an opportunity to reflect on different perceptions within the group and in other sectors in society and become aware that our perceptions sometimes differ from reality. The goal is to reflect, instead of getting correct answers.

Objective: To reflect on and discuss our own perceptions and perceptions in society in general in regards to stereotypes in STEM and gender.

Materials: Printable cards

Preparation: Each card has a question and a hidden answer, following this design:

The information is based on the European Commission public opinion report.

Duration: 30 minutes

Description:

This activity is suitable for everyone: students, teachers or any other citizens. Participants are told to agree on one answer to a question, so they need to discuss and reflect about it before they see the answer. After that, each partner explains their answer to the other group(s) and the reason they chose it.

Process

1. Make 3-4 participant groups.
2. Read the question and agree on an answer (5 minutes).
3. Check the answer and reflect on the reasons (2 minutes).
4. Explain to the other groups your reflections on the question (5 minutes).
5. Repeat two times.
6. Pooling among all the groups. Which was the most interesting reflection?

Use national examples, numbers and figures.
Mix the group of teachers who know each other with the others.

»The perception quiz is a great way of knowing each other better and starting discussions based on the opinions of the participants.«

»Nice reflections, surprised to see the result of some questions.«

Stable Table

This activity introduces the engineering design process and offers the opportunity to experience it. Participants undertake a short challenge: they make a structure that can hold a tray with drinks. They discover that when undertaking this challenge (or solving other problems) it is very natural to use some form of design cycle. While most people instinctively use a design cycle and choose their role in it, most of the time they are unaware of this.

This activity helps all types of people understand and appreciate the role of gender bias in the design cycle. The activity stimulates participants to think outside the box and become aware of any unconscious biases they might have.

Objective: To succeed or fail in undertaking this challenge.
To find out that the design process is instinctive and used frequently in daily life.
To learn the different steps of the design process.
To develop gender awareness in STEM activities.

Materials: Per group:

- 1 newspaper, tape, a pair of scissors, a ruler.
- 1 tray with 2 drinks (for example, 2 coffees) and a plate of cookies.
- 1 large illustration of the design process (PowerPoint slide or poster).
- 1 flip chart with markers.
- 1 hairdryer (optional).

Preparation: Organise the tables with the chairs (one per participant) and organise the materials so that you can distribute them easily (5 minutes).
Give careful consideration to the composition of each group, preferably with a diverse composition (for example, three men and three women). Gender awareness comes with the selection of the facilitator and the role distribution within each group, decided under "stressful situations" (after finishing the task, the participants will check if that election was gender biased).

You can give the groups a maximum length of tape; for example, 15 cm. To make it even more challenging, you can use a hairdryer to test whether the structures are stable.

Duration: 50 minutes

Description:

Introductory activity – the challenge

Imagine that you're relaxing in a designer lounge chair. It's lovely weather, and you're enjoying your book and a nice drink! But when you want to place your drink on the ground, you find you can't reach it. Clearly, the designer chair has not been designed well.

- How might you solve this problem? Let the participants respond.
- The challenge is to build a structure that can hold a tray with two cups of coffee and a plate of cookies.

To give the participants ownership, decide together what should constitute a successful challenge; for example, how high should the structure be?

Ask, imagine, plan and create

1. Do the following in the group as a whole:
   a. What do you need to know?
      Ask the participants and write the questions on a flip chart.
   b. Any further questions?
      Answer participants' questions about criteria and restrictions (Do all of the groups know which materials they can use and how much time they have?).
   c. Explain how the structure will be evaluated.
      It will be successful when the cups can retain their contents and the structure has a minimum height of 30 cm. Will the hairdryer be used?

2. Do the following in groups:
   a. The groups have 15 minutes to create their table.
   b. While the participants are building, walk between the groups, observe, and ask what they are doing and why.
   c. Warn the participants when they have five minutes left.
   d. After 15 minutes, the participants should stop building.

3. Evaluate each structure. Get all of the participants to gather round a structure:
   a. Test the structure.
   b. Ask what this group has done and why.
   c. Ask what would they have done differently if they could repeat the challenge?
   d. Do this for all of the structures.

Conclusion and reflection

Discuss the following with the group as a whole, everyone returns to their seat:

Thinking about the process, what have you done? Each group discusses and writes down:

- Which actions they undertook to complete the challenge? -> Write down in five or six action words
- How were the roles divided? ->Discuss: consciously or non-consciously?
- Who performed these actions? ->Discuss
- Is there a specific type of person needed for this action? -> Write down in one or two words, next to the action words

Then in plenary ask which action words they have written down and write them on a flip chart (try to group similar words).
After that, link the groups of action words to the design process (Explore, Imagine, Design, Create, Improve). Explain that they all undertook the challenge in a form of design process. Perhaps the order was slightly different or some steps were merged, but this does not matter. Most people – especially students – need additional structure and help during the 'ask' and 'plan' steps.

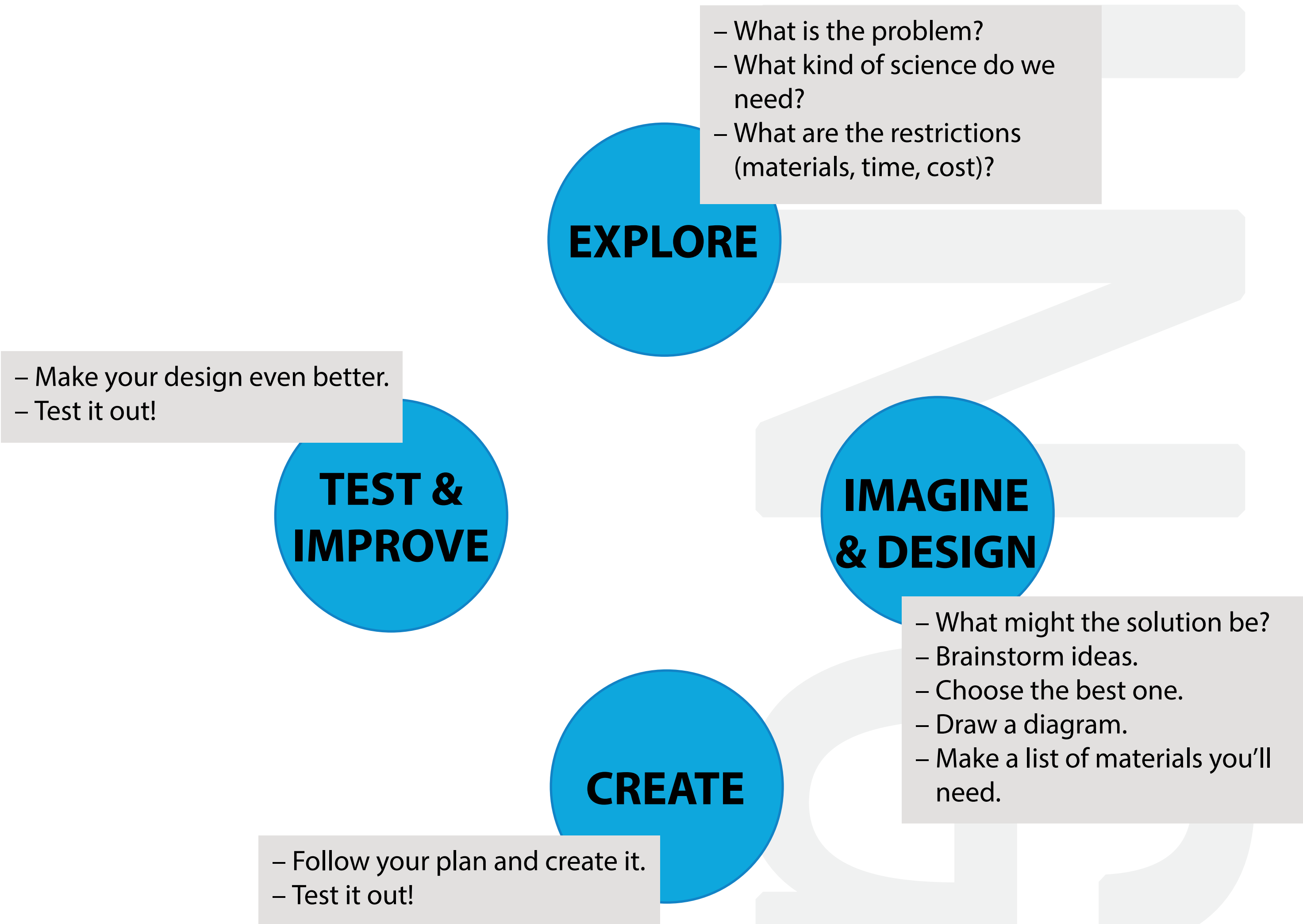
»Great for bonding and stimulating participants to think out of the box«

Ask how they think this activity links to gender inclusion?

- Ask whether they selected the roles consciously or not. Was this selection gender biased?
- Discuss what they wrote down about the type of person needed to do the specific action words formulated with every step within the design process. Unconsciously, men and women are often put in specific roles, even though this role might not fit the type of person he/she is. It does not count whether you are a technology-type of person to complete this assignment.

  There are various roles to take within the design process, which indi cates that students with different preferences can take an active role that suits them.

  - The story that explains the problem might appeal to students with more language-oriented preferences.
  - The technical challenge might appeal to students with a prefer ence for detail.
  - The time limit might appeal to students with a preference for competition.



Group Two Activites

CLASSROOM PRACTICE

MicroBot Technology

This activity encourages the creation of teaching and learning activities to support an inclusive classroom through encouraging the development of STEM understanding. The context, of creative robot dance, reflects a popular theme in the modern world and appeals to a wide audience. The result is a STEM activity more grounded in sound STEM knowledge principles and utilising creativity and collaborative learning in an inclusive classroom. The focus remains on high calibre programming, and developing skills, knowledge and understanding.

Objective: Microbot Technology seeks to expand the application of technology through computer programming. The aim is to create a student friendly and inclusive context to support learning in computer programming though problem solving.

Materials:

- Micro Robots <http://www.picaxe.com/Hardware/Robot-Kits/PICAXE-20X2-Microbot/>.
- Computers, projector and screen.
- Floor space or large table to test robot program.
- Flowchart software <http://www.picaxe.com/Software>
- Worksheets <link: STING_worksheet_MicroBot Technology.docx>;
- Booklet <link: STING_workbook_MicroBot Technology.pdf>.
- The room should consist of five large desks and chairs for groups of four people with computer (up to a maximum of 20 participants).

Preparation:

MicroBots batteries are checked. The software is installed on the computers and checked in advance. The trainer-computer with a PowerPoint presentation is loaded (to complement the workbook) and flowchart-programming software is installed for

"By encouraging pupils to come out of their comfort zones, it enabled them to develop skills"

demonstration.

Duration: 50 minutes

Description:

The Project relates to previous learning in a range of subjects and application of existing knowledge. The activities also encourage teamwork, collaboration, discussion and exchange of views. Initial approaches to STEM can often be activity based. Using robots as a means to inspire and engage students in programming and practical use of technology offers substantial educational potential.

Activity
Students grouped in teams to collaborate on a shared activity.

- The activity is designed to last 50 minutes and has the following structure:

1. Explain the relationship between algorithm, flowchart and programming.
2. Provide instruction on nature of commands.
3. Create paper-based algorithms for simple robot movements.
4. Translate algorithms into programs and run programs.
5. Create a robotic dance routine to display creativity.

- The program design of the dance routine is a shared task, which involves the combination of dance moves provided by all members of each team.
- Each dance showcased and scored by the teams, identifying elements of successful program design.
- There are no right or wrong solutions, all responses are valued.

Design and creativity is encouraged through:

- Creating a path or dance for MicroBot.
- Design of robot personality.
- Flexibility in design to allow wide range of responses.

This approach encourages teamwork and gender inclusivity to sketch, plan and construct dance routines as a shared task, through a combination of dance moves suggested by all members of each team. Use of the open-ended dance routine opens the STEM activity to include both the exploration of creative and expressive movement and the application of technology and mathematics.

The plenary therefore becomes a showcase celebration, which is a more inclusive experience where all responses are valued and challenged.

"Great use of resources, discussion and activities designed to challenge preconceptions. Worked very effectively."

Extension activities include possible costume design, or relating movement to music.

Task Preferences!

This is an activity to make teachers aware of the varied preferences of students whilst involved in making decisions for classroom tasks. In this activity, participants are asked to solve a problem by developing and improving a technology. They are asked to design and build their own vacuum cleaner, hair dryer or toy car. The participants generate creative solutions to a challenging problem and work like engineers. These tasks focus on STEM (Science, Technology, Engineering and Mathematics) practices and the relationships between STEM practices and concepts. Through such practical real-world connections, students have an opportunity to see how STEM is part of their everyday world.

Objective: To highlight the nature of a task by considering its strengths and weaknesses in relation to gender balance in STEM activities.
For students, some other objectives of the task are:

- To learn about electric circuits and the direction of current.
- To learn how to use batteries, small motors and (design) fans.
- To learn about the different parts of a vacuum cleaner, hair dryer or toy car.
- To experience the importance of group work in arriving at creative solutions to a challenging problem.

Materials: Actual materials that are necessary to carry out the activity can also be provided to participants and they can carry out these tasks:

- Pencil and paper for each participant.
- Small motors 1,5-3V.
- Batteries 4,5V or 3x1,5 V.
- 3 x AA Battery Box.
- Solid Core Wire.
- Solid Core Wire resistance.
- Plastic bottles from 0,5-2 litre and plastic bottle lids.
- Paper fasteners.
- Paper clips.
- Wire strippers.
- Pieces of cardboard 10 x 10 cm.
- Debris from a hole puncher.

- Glue pistol.
- CDs.
- Thick wood sticks or lollipop sticks.

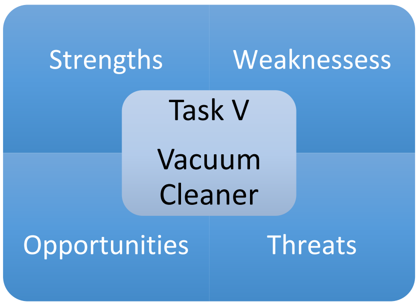
Preparation: None if solely performed as a design exercise, although if actual materials will be used, these materials should be prepared before implementation.

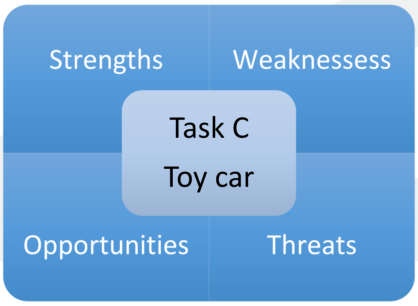
Duration: 60 minutes

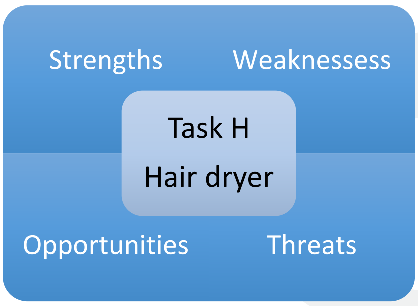
Description:

Group work
Groups of 4-5 students.
- Brainstorming: inquiry, planning and design, and drawing on a sheet (15 min).
- The building of a chosen artefact (30 min).
- Presenting their design/actual artefact to their classmates (15 min).

This activity is suitable for 11-12 years old students to carry out in the classroom. Ask participants to choose whether they would use Task H, V or C and to provide a justification for that. Thereafter, discuss and report the SWOT analysis (see below). You may ask some of the following questions:
- Which task did your students prefer and why?
- What advice might you give to a new teacher doing these tasks for the first time?





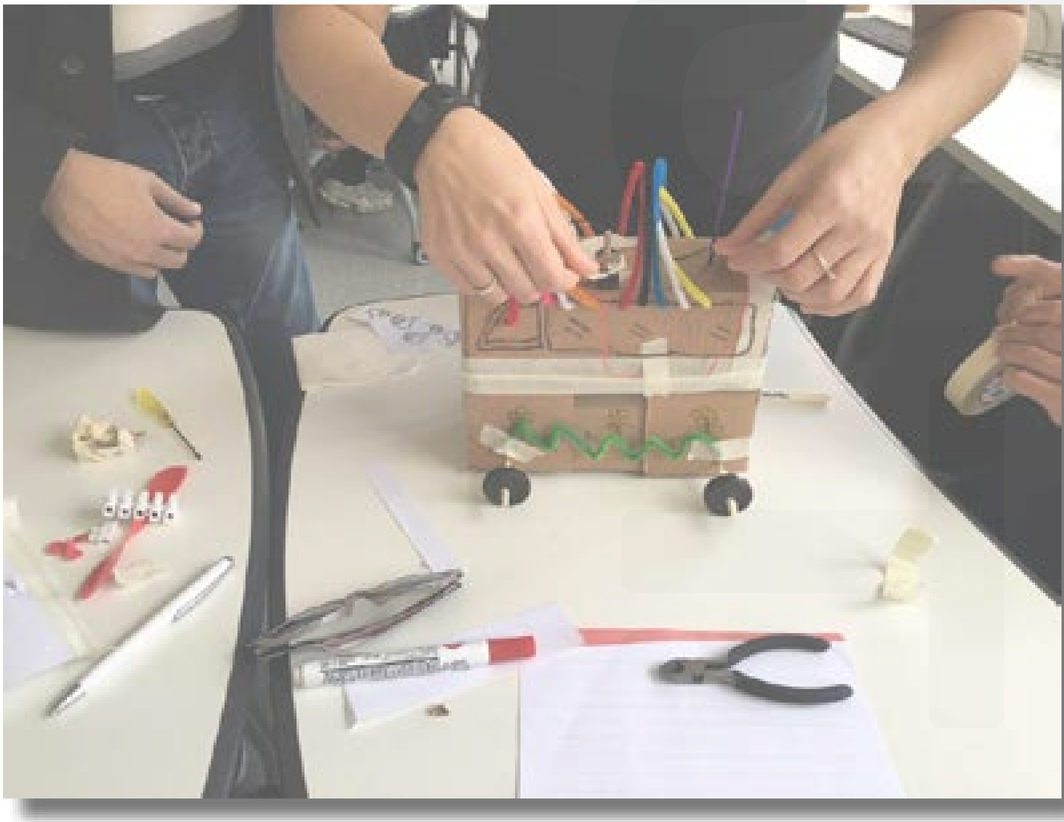


More information

If you want to know more about gender issues in STEM and how vacuum cleaners or hair dryer work you can look at these websites:

- How stuff works – vacuum cleaner
- How stuff works – hair dryer
- Engineer – vacuum cleaner
- Journal of Research in STEM Education (J-STEM)

»It allows us to look at STEM in an engineering aspect. Assessment and evaluation of what we have done was very nice. It is good to involve boys nd girls. This activity can offer gender equality.«



STEM Education and Sensitivity to Gender

This activity is to be used after teachers have seen, presented, discussed or engaged in various STEM education activities. Its scope is to help teachers organise theoretical principles that are important to keep in mind when teaching or designing lesson plans in STEM education. This will enable them to develope inclusive strategies for both female and male students in these lessons.

Objectives:

- To identify knowledge from research about gender differences in STEM education.
- To identify knowledge from STEM education that highlights the role of women in STEM.
- To identify, develop and utilize teaching strategies for being more sensitive to gender differences during teaching and learning in STEM education.

Materials: PowerPoint presentation slides & Reflection worksheet

Preparation: There is no need for any special preparation for this activity. The room should be customized in a way that would enable participants to discuss ideas, face each other and communicate in whole group formation. If teachers can be grouped based on their school or the age groups taught, then some of the discussions may start in smaller groups that will report to the whole group later on. Please note that the activity is not intended solely as a lecture. The PowerPoint presentation is intended as a prompt for discussion and exchange of ideas and good practices. It is also meant to help teachers organise their ideas and experiences into a theoretical framework that can help them take everyday teaching decisions in relation to gender sensitivity in STEM education.

Duration: 120 minutes

Description:

The activity is mostly based on a PowerPoint presentation that can be adapted and changed based on particular group of teachers' needs, level of education etc. It is meant to provide opportunities for discussing ideas, issues, difficulties, and possibly agreement and disagreement of participating teachers related to raising awareness for gender sensitivity during STEM education. Towards that direction, the presentation has two sections.

1. The first section gives a short overview of what we have learnt in the past 10 - 15 years about improving gender imbalance in STEM education. The section talks about findings from the literature concerning what we have discovered about gender differences/issues/sensitivities in STEM teaching over the past 10-15 years (student and teacher views, support groups, the role of family, informal science learning, topics for learning in science that interest both genders, the role of mathematics, relation to communities of practice, why school practice needs to be authentic, what authentic looks like, interaction and active participation, democratic teaching style, in depth vs. lots of topics, evaluation methods).

2. In section two, characteristics of authentic STEM education teaching and learning are presented in order to highlight ways of using STEM education for promoting equal learning opportunities for both genders. This is done in an effort to relate inquiry-based characteristics of STEM education to findings about gender issues and gender-sensitive teaching.

The presentation starts and ends with two different reflection activities. The first one asks participants to reflect on what has been previously discussed about issues and STEM activities related to gender balance. The second reflection asks participants to identify 2-3 problematic issues/situations etc. related to gender balance in education in their school context that they can address through STING Teacher Professional Development (TPD) modules.

»I enjoyed how practice and theory were connected.«

»Trying out and discussing activities for raising gender awareness has helped me identify alternative ways of working with my students in the class.«

Storytelling – a Strategy for Building Conceptual Knowledge and Skills in Primary Science

Storytelling activity is a group activity aiming to promote the creation of teaching and learning activities to support an inclusive STEM classroom through encouraging the development of STEM understanding.

Objective:	To explore environmental and scientific concepts through storytelling. The central concept underpinning the story-based approach is the promotion of scientific inquiry as a vehicle for developing scientific literacy. The teacher/facilitator can use the narrative and language of story to support the learner in becoming familiar with the language of science and the scientific method.
Materials:	Storybook ; poster materials, pens and boards. Group seating (4/5 people) with large desks suitable for poster creation with board to present poster in plenary session; computer with PowerPoint, projector and screen.
Preparation:	The teacher/facilitator should be familiar with the details of the story and the scientific concepts developed through the story; the teacher/facilitator may wish to scan the storybook for presentation as a PowerPoint to the whole group or provide one copy per group.
Duration:	50 minutes

This approach was effective with student teachers; it enabled them to forge links between science knowledge, pedagogy and critical reflection on their professional practice. The activity also encouraged teamwork and exchange of views on alternative strategies in the use of elements of the story to support STEM learning in all children.

Description:

The pedagogy associated with this storytelling strategy involves scaffolding the learner's current understanding, with the new learning in STEM, via the story. As the learners develop key scientific skills, they can better engage with progress and developments in science and technology through the media.

The teacher/facilitator reads the story through and initiates group discussion on the effectiveness of the use of the storytelling strategy as a mechanism for promoting conceptual learning in science in all children. However, research indicates that female students engage with the narrative and characters in story to a greater extent and for a longer time than male students, whereas male students disengage sooner and are less likely to identify with characters in the story (Logan & Johnston, 2009). It is advised, therefore, that groups identify elements of the story that may lead to gender bias in engagement and consider strategies to optimise learning for all children, for example, setting mini-targets for all students, which incorporate activities with an element of movement, competition, creativity and discussion. Each group is tasked with the production of a poster to be presented during a plenary at the end of the session.

Discussion points for the storytelling exercise include:

- **Key features of the story**
  Identification of main characters, plot and development.
- **Engagement and enhancement of educational concepts in science and literacy**
  How can children link key concepts in science and literacy to further support their learning?
- **Gender bias in the story**
  Are there different elements in the story that would appeal more to one gender?
  Can the teacher/facilitator exploit particular elements to better engage all children?
- **Development of natural curiosity into an awareness of STEM subjects, careers and opportunities**
  How does the story build on children's curiosity about the world around them?

Changing Practice

This activity illustrates how a storytelling session might be reimagined to inspire and engage all children, as well as teachers/facilitators, in the discussion of major scientific concepts and skills. In the case of the exemplar, "Mr Blueberry" incorporates problem solving and the development of understanding of the scientific method. Choice of the storybook is key and it is important to ensure that all activity objectives correspond to the central concepts included in the story. The plenary becomes an opportunity to showcase and discuss awareness of gender and best practice in STEM

STEM Story Bank

S. (1996). Dear Mr. Blueberry. New York: Aladdin Paperbacks, an imprint of Simon & Schuster.

Carle, E. (2001). The tiny seed (Aladdin picture books). New York: Simon & Schuster Children's Publishing.

Pollard, N. (2002). The tide. Thousand Oaks, CA, United States: Roaring Brook Press.

Waring, G. (2008). Oscar and the moth: A book about light and dark. Cambridge, MA: Candlewick Press (MA).

Murphy, J. (2013). Peace at last. London: Macmillan Children's Books.

Donaldson, J., & Scheffler, A. (2006). The snail and the whale. New York: Penguin Group (USA).

Donaldson, J. (2017). Monkey puzzle. United Kingdom: Macmillan Children's Books.

Meserve, A. (2006). No room for Napoleon. New York: Farrar, Straus and Giroux.

Arnold, T. (1998). I'm falling to bits! Hove: Macdonald Young Books.

Additional Support Material

Hickey, I., Quinn, C. & Magennis, G. (2009) Linking Science and Story for Primary Education Students. Science Teacher Education, 56, 5-13.

http://www.handsonict.com/sciencet/files/scienceteachereducation_unit2.pdf

http://blogs.scientificamerican.com/budding-scientist/to-attract-more-girls-to-stem-bring-storytelling-to-science/

http://www.ngcproject.org/blog/storytelling-using-fiction-engage-girls-stem

Logan, S. & Johnston, R. (2009). Gender differences in reading ability and attitudes: Examining where these differences lie. Journal of Research in Reading, 32(2), 199-214.

»The story telling activity worked very well and elicited a great response from participants, generating questions and discussion of ideas. Feedback identified aspects of the story that would appeal to girls (narrative, emotion, empathy with characters) and boys (facts and short letter format). It also highlighted how the main female character as the "scientist" engaged in the scientific method of trial and error and overall the storytelling activity would promote "problem solving" and help "develop imagination and creativity", while "increasing [scientific] knowledge and understanding".

Feedback

This activity aims to share practical tips on how to use constructive feedback as a positive way of making the teacher or student aware of his/her strengths and of where to improve.
By having a structured way of offering feedback, both female and male students learn to give and receive feedback. Female and male students are often not given feedback in the same way and therefore don't get the same opportunity to improve.

Objectives: To learn to give and receive feedback in regards to your own communication and presentation skills. To develop confidence in these skills as well as self-confidence in science.

Materials: Feedback sheet

Preparation: Copy the feedback sheet.

Duration: 15 minutes per student (+ time allocated for each student to present)

Description:

Feedback is a constructive way of improving one's ability as a communicator and presenter. It is important that the person receiving feedback is in control of the process. If this person feels that the feedback is being forced upon them, they are likely not to use the feedback. That means that the person receiving the feedback decides on the focus of the feedback and the (two or three) focus areas. This also helps the supervisors to focus when observing someone presenting.

The most important thing is that feedback is an opportunity for participants to improve their presentation and communication skills, and not an opportunity for the supervisors to be critical.

There are 3 rules when giving feedback.

1. The feedback can only be on the topics chosen by the presenter.
2. The comments must be constructive.
3. The people giving feedback are only allowed to make three comments:

two positive comments relating to what the presenter did especially well and one comment on something that could be improved.

Three people from the audience are chosen to give feedback. The presenter tells the supervisors what they should focus on when observing the presentation.
After the presentation, the presenter is asked to share his/her opinion of the presentation. The observers then share their observations, but only on the topics chosen by the presenter. This is not a discussion, but a dialogue between the presenter and the supervisors. As a way of remembering the feedback, the presenter writes down what he/she finds most useful on the Feedback Sheet.

» This is a very practical and simple activity to do with a huge impact.«

Concept – Context

The activity is designed to create awareness of gender bias in teaching materials.

Objectives: To stimulate teachers to try different approaches that might attract a more diverse group of students to science, technology, engineering and mathematics.

Materials: Teachers can either bring their own textbooks or you can prepare some male- and female-oriented exercises in advance. Pencils and paper.

Preparation: Teachers can either bring their own textbooks or you can prepare some male- and female-oriented exercises in advance. Pencils and paper.

Duration: 20 minutes

Description:

Ideally, each group should consist of four to six teachers. They are given one or two exercises, which they have to modify to make them more "girlish" or "boyish".
We show our participants that examples in school science textbooks are usually taken from a male world. By devising alternative situations, which are more relevant to female students, we might be able to inspire more of them to take an interest in Science & Technology. This activity also raises awareness, because many teachers have not noticed the inherent gender bias in their textbooks. By trying to rephrase exercises in a way that will interest female students, they may think about offsetting the male orientation of the current versions.
Note that in biology we have found that the trend is in the opposite direction, with textbooks containing more female-oriented examples and exercises.

»Until now I haven't realised that exercises in textbooks had a gender orientation«

Tips & Tricks: Improve Your Gender Awareness in the Classroom

These hand-on tips & tricks will help the teachers to address her/his students in a gender-inclusive way.

Objective: To support eachers to be able to make their practice more gender inclusive.

Materials: Give away bookmarker.

Preparation: Make sure to have enough bookmarkers to hand out.

Duration: 2-15 minutes (depending on the explanation you want to give).

Description:

Checklist for teacher trainers:

Acknowledge the expertise of teachers. Teachers know how to teach their students. You do not need to tell them that. However, they appreciate support and specialised knowledge about how to teach STEM topics. Therefore, make use of their knowledge and expand it with your specialist know-how in STEM education.

Make sure that participants enjoy the training. They are more likely to use the information acquired if they have good memories of the day.

Keep in contact with the participants. Research tells us that, for professional development to be really effective, it needs to be embedded in teachers' pract ice. Teacher trainers can support this by staying in touch with participants and sending them follow-up suggestions from time to time. This is also a good way to monitor the long-term effects of a training or professional development activity. Below, you will find an example of how this can been done during a gender awareness training (bookmarker).

»Good, easy way to keep something in the picture.«

It is important to set a clear goal for the programme and to make that explicit to the participants, so they can see what they will gain from the session. Make it clear how this course as a whole and each particular activity will benefit a teacher's work.

Checklist for teachers:

Language:

- When writing a text, make sure that is relevant to all types of students.
- Ensure that both sexes are in the text.
- Address both female and male students.
- Avoid asumptions such as boy are lazy, gils are smart.
- Avoid the word "man" as part of another word. For example, manpower.

Educational practice in the classroom:

- Give the female and male students equal turns.
- Provide the students with prescriptive, informational content and feedback regarding their performance. Such feedback enhances students' beliefs in their abilities.
- Commend students as much for their services, activities and initiative as for their cleanliness, diligence and good behaviour.
- Ensure that all students stick to agreements.

Didactic:

- Analyse learning content and resources on gender awareness.
- Search for topics that appeal to both female and male students.
- Vary the working methods.
- Ensure that when students work in groups, both female and male students have leadership and administrative tasks.

Non-verbal communication:

- Nod encouragement to all students.
- Give equal attention to the undesirable behaviour of both female and male students.
- Undesirable behaviour comes in different forms. For example: running in the classroom; giggling during instruction.

Write a Letter to Yourself

This activity is set up as a wrap-up or follow-up of a workshop where gender and gender inclusiveness has been the focus.
After having reflected on different gender approaches, each participant will reflect and write up their conclusions about the training, evaluating their personal ideas about gender and their own teaching and behaviour in the classroom.
The outcome is a letter that the facilitator will send to them describing three "gender resolutions" that they aim to integrate in their teaching in the near future. It will work as a reminder when the letter arrives several weeks later.

Objective: To reflect on preconceptions on gender and the extent to which these affect your teaching in the classroom.
To act on this reflection and make adaptive changes accordingly.

Materials: Pens, postcards, envelopes with stamps

Preparation: Prepare the postcards.

Duration: 20 minutes

»Reminder is always needed, either this or a comeback day where people present homework.«

Description:

This is an individual and personal activity. We want the participants to be honest about their own gender biases and preconceptions.

The activity forms part of the evaluation and closure of the workshop.
At the end of the session, each participant is given a postcard and an envelope. The postcards are premade with the following text:

> Dear ______________________
>
> Remember that you made a gender-resolution about paying special attention or making concrete changes in regards to the following:
>
> 1: ____
>
> 2: ____
>
> 3: ____________________________________
>
> when teaching school pupils and when collaborating and discussing with colleagues.

Each participant completes the postcard and places it in a self-addressed envelope, which is sent to them 2 or 3 weeks later. If possible this is followed up with phone calls in which, amongst other things, participants are asked if they managed to fulfill some or part of the resolutions they made, and whether they have had a particular focus on gender in their work since attending the workshop.

»To see real changes – resolutions must evolve into adaptive changes.«

Referencing the toolkit:
Bronzwaer, L., Cakmakci, G., Gray, P., Hughes, J., Lasa, A., Laursen, S., ... van Laar, M. (2017). STING – STEM Teacher training innovation for gender balance. Usurbil, Spain: Elhuyar Foundation

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