The toolkit is a ready-to-use digital collection of modules aimed at teenagers to be used by teachers, informal learning organisations, researchers and industry.

The aim is to engage young people and especially girls in STEM and in the discovery of the variety of STEM related careers in a gender inclusive way. The toolkit includes a wide range of hands-on activities: workshops with a scientific content, informal discussions and meetings with STEM professionals.

Each module is composed of three guidelines:

• Explanatory guidelines specific for each activity
• Guidelines dedicated to the theme of gender inclusion
• Guidelines with suggestions for the facilitation

The guidelines give practical support and guidance for the users, recommendations on how to debate gender approaches and differences with young people, support and guidance for facilitators on how to overcome their own stereotypes and suggestions on how to manage the group dynamics by implementing different facilitation strategies.

The toolkit is produced in the context of the Hypatia project by five science centres and museums (NEMO Science Museum, Museo Nazionale della Scienza e della Tecnologia “Leonardo da Vinci”, Bloomfield Science Museum Jerusalem, Experimentarium, Unierscience) in collaboration with gender experts, teachers, research industry institutions and teenagers.

The Vision of Hypatia is of a European society that communicates science to youth in a gender inclusive way in order to realise
the full potential of girls and boys around Europe to follow STEM related careers.

Below is the complete list of modules that compose the Toolkit, divided into the three contexts.

**Schools**
- Find Gender Stereotypes in STEM Representations
- Gender Inclusiveness in your Science Teaching
- Inquire: Shape and Action
- Play Decide Game & Debate
- Science Ambassadors and Ambassadresses
- STEM Women Cooperative Card Game
- Test Yourself
- What’s your Opinion?

**Science Centres & Museums**
- Find gender stereotypes in STEM Representations
- Science Café or Café Scientifique
- STEM Women Cooperative Card Game
- Test Yourself
- Wearable Technology
- Your Role in Research: Inquiry into Chemical Reactions

**Industry & Research Institutions**
- Gender optimizing software programming
- Science Ambassadors and Ambassadresses
- Skill Game
- Speed Dating
- Your Role in Research: Inquiry into Chemical Reactions

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**PLAY DECIDE GAME & DEBATE**

**AT A GLANCE**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>14 – 18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Format</td>
<td>Moderated discussion</td>
</tr>
<tr>
<td>Duration</td>
<td>90 – 120 minutes</td>
</tr>
</tbody>
</table>

**OVERVIEW**

An activity very easy to be transferred to many contexts. A discussion session for students, on the **stereotypes for working in STEM in your society**.

To prepare the students for this debate, they play a debate game led by their teacher. During this game, the students will think of a solution for the problems and dilemmas they encounter during the game. After the game, the students make a poster with their solution.

After a short break the debate starts. The debate is led by a moderator (the teacher) and accompanied by an expert panel (some students). The spokespersons for each group of students present their poster with a brief pitch. The expert panel review the solutions and arguments and share their experiences.

Then a number of statements are presented. The students vote for each statement. In response to the result of the vote the students debate with each other and the experts about the propositions.
OBJECTIVES
The object of the game is to explore (together) the topic of stereotypes within working in STEM in your society and knowing what thoughts and beliefs there are on it.
If desired (determined by the group itself), actions can be linked to the topic.

SUGGESTED SCENARIO
At school during a theme week, during class like in the (Dutch) subjects: social science; sociology; economics; human and nature; nature, life & technology; worldview and language, history; technology; philosophy.

TARGET AUDIENCE

<table>
<thead>
<tr>
<th>Age</th>
<th>14 – 18</th>
</tr>
</thead>
<tbody>
<tr>
<td>N. participants</td>
<td>10 –30</td>
</tr>
<tr>
<td>N. facilitators</td>
<td>3-6: 1 facilitator &amp; 1 moderator each 5-10 students &amp; a 3 persons expert panel</td>
</tr>
<tr>
<td>Type of audience</td>
<td>secondary science education students</td>
</tr>
</tbody>
</table>

FORMAT
Moderated discussion.

TOPICS COVERED BY THE ACTIVITY
This activity has connections to the science curriculum for job orientation and has gender and STEM as main topic.

DURATION OF THE ACTIVITY
1,5 to 2 hours.

RESOURCES

<table>
<thead>
<tr>
<th>MATERIALS</th>
<th>Annex</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placemats</td>
<td>Annex 1</td>
<td>1 for every student</td>
</tr>
<tr>
<td>Big A3 placemat</td>
<td>Annex 2</td>
<td>1 per group</td>
</tr>
<tr>
<td>Glue (pritt)</td>
<td>Annex 2</td>
<td>2 per group</td>
</tr>
<tr>
<td>Pens</td>
<td></td>
<td>1 for every student</td>
</tr>
<tr>
<td>Markers (Edding)</td>
<td></td>
<td>3 per group</td>
</tr>
<tr>
<td>Highlighting markers</td>
<td></td>
<td>3 per group</td>
</tr>
<tr>
<td>Flip-over or standard for the poster</td>
<td></td>
<td>1 per group</td>
</tr>
<tr>
<td>Scribble sheets</td>
<td>Annex 3</td>
<td>2 per group</td>
</tr>
<tr>
<td>Scotch</td>
<td></td>
<td>1 role per group</td>
</tr>
<tr>
<td>PlayDecide Information cards</td>
<td>Annex 4a</td>
<td>1 set per group</td>
</tr>
<tr>
<td>PlayDecide Opinion cards</td>
<td>Annex 4b</td>
<td>1 set per group</td>
</tr>
</tbody>
</table>
USEFUL LINKS, VIDEOS, ARTICLES

- www.Playdecide.eu

SETTING

- Each group/table consists of 4 to 10 players (students) and one moderator. Divide the group in girls, boys and/or mixed groups, to your own preference.
- Choose the moderator(s) before the activity and choose with care; students might react better to a charismatic person that has experience in leading conversations with students or some might react better to a young person with whom they can identify better. Either a teacher, parent or student can be the moderator.
- The expert panel should consist of at least three people. These can be either: invited professionals who work in STEM or parents or even some students.
- The activity could be split in two and done on two separate moments.
- When finding facilitators/moderators for a whole class is hard,

- Try to split it up in two sessions with half the group. Maybe in combination with the *Find gender stereotypes in STEM!* module.
- De facilitator can be a moderator as well.

DESCRIPTION AND TIME SCALE

GROUP MANAGEMENT

Tips for the facilitator/teacher:

- Listening is important.
- Try not to do much talking yourself, but guide the conversation.
- Try to understand what they are thinking, to possibly help them to bring things into words, but do not try to persuade them. You cannot control the outcome!
- Try to have people to hold onto what they are thinking about something and look for the similarities.
- Try to give turns to everyone and wait until the other person has finished speaking (if it takes too long, ask whether they want to finish as time is limited, so that others can get their turn as well).
- The word "but" can often work inhibitory. For example, use the word 'and', which makes it a bit more open.
- Keep the time: In the session before the defence we have only one hour of time. Make sure you have moments of rest (for example, while reading and wait until everyone has finished reading) before you start. Also ask the students to keep the cards to themselves, since we then are going to tell what cards they have chosen and why. If they do start chatting, ask them to think about why they chose that card and what their arguments are for this choice.
INTRODUCTION

Introduction, 5 - 8 minutes.

The facilitator/teacher starts with a brief plenary explanation of the purpose and the program (see annex 6):

- Explore the topic of stereotypes for working in STEM in your society and knowing what thoughts and beliefs there are
- Find arguments to support your opinion
- Recognize the opportunities to break down the existing stereotypes
- Link actions to the topic.

Programme:

- Round 1: Choose information cards
- Round 2: Choose opinion cards
- Round 3: Discussion & find themes
- Round 4: Solutions/actions & poster
- Round 5: Debate
- Round 6: Award (optional).

The facilitator explains the criteria on which the expert panel will evaluate (to be determined by the expert panel). Then every moderator will repeat this in each group and decide who’ll be the spokesperson who:

- Is going to do the pitch before an expert panel.
- Takes notes in round 3 and 4 on the scribble sheets. These can be put on the wall.
- Writes down the results (on a large sheet, the moderator takes notes as well on an own paper).

- Ask if any student wants to be that. If there are multiple, pull straws. If nobody wants to do, make a choice.

After that, explain what material is on the table and point out the structure in the next hour:

- The placemats: one per individual and a bigger shared one. You use the placemat the first two rounds, to keep an overview and it states the game proceedings.
- Each student also has its own placemat with the same information on it
- The cards:
  - The green information cards contain information, so you’re fed with facts, general views of the population, etc. on STEM and diversity (including a wide example of STEM subjects to interest a wide group of students)
  - The blue opinion cards contain opinions (some complicated or even provocative), open problems, questions, etc.
- The scribble sheets: that they can use in round 3 and 4.
- The poster: is where they should note their slogan and arguments in a neat and tidy way. Best to ask someone with good handwriting to do the writing (on the flip-over next to the table).

Explain the terms of gender, stereotypes, diversity and prejudice (see the gender guideline for definitions).
DEVELOPMENT OF THE ACTIVITY

Round 1: Choose info cards, 5 – 8 minutes.
1. Each player gets four green information cards (shuffle the cards before and hand them out one by one, so not the first four to player 1). These cards state facts & figures on the topic of stereotypes within working in STEM in your society.
2. Each player chooses one (preferred) card, they have a strong opinion about.
3. Go around the group: Everyone reads their own card and explains why they chose that card. (Please note that there is no discussion yet! Ask the students to write down, if they would like to say something, on a specific card.)

Round 2: Choose opinion cards, 5 – 8 minutes.
1. Each player receives four blue opinion cards (shuffle the cards before and hand them out one by one, so not the first four to player 1). These cards state thoughts & beliefs on the topic of stereotypes within working in STEM in your society.
2. Each player chooses one (preferred) card, they have a strong opinion about.
3. Go around the group: Everyone reads their own card and explains why they chose that card. (Please note that there is no discussion yet! Ask the students to write down, if they would like to say something, on a specific card.)

Round 3: Discussion and find themes, 20 – 30 minutes.
1. Start to address the things that students wrote down in rounds 1 and 2 to start the discussion.
2. Do we want to share something on our, or each other’s choice?
3. Give space when students still have questions to someone else or to share personal experiences or situation, they heard about, that happened because of stereotypes.
4. A discussion can occur from it, and give a head start to the start of clustering themes. (You can help by suggesting e.g.: Education; Cultural/Social; Behavioural Psychology; Political/economic; Biological)
5. If this is not the case then, for example, choose one student and allow him/her to re-read his/her card out loud. Then you can ask, Does anyone have a card that matches this, according to his/her feelings/opinion?
6. Are there any similarities between these cards? Are there contradictions or not? What theme do we, as a group, find interesting? Try here to elicit a discussion by linking cards together.
7. (You can choose to give the moderator an overview of the texts of all the cards to be able to refer to in the discussion).
8. Together, try to reach a minimum of 2 to 3 themes with cards that contain a similar message or idea referring to stereotypes for working in STEM in your society.

Round 4: Solutions/actions and poster, 25 – 40 minutes.
1. Consider a number of solutions/actions following the chosen main topic: the existing stereotypes for working in STEM in your society.
2. As moderator you make an inventory of what comes by and you summarize it together on the common grid.
3. The spokesperson of the group writes it on a large sheet, you're on your own paper as support.
1. After that you can give them your own paper, so they can make their slogan and poster.
4. The group makes their slogan & poster. And the spokesperson prepares her/his 30 sec. presentation.

CONCLUSION

Round 5: Debate, 30 - 45 minutes.
1. After a (short) break the debate starts.
2. The debate is led by the facilitator and accompanied by an expert panel. The spokespersons for each group of students present their poster with a brief pitch in no more than 1 minute (aim for 30 seconds).
3. The experts and fellow students can immediately respond. The expert panel review the solutions and arguments and share their experiences.
4. The facilitator writes down the important statements (worthwhile to remember).
5. Then a number of statements are presented. The students vote for each statement. In response to the result of the vote the students debate with each other and the experts about the propositions.

Round 6: Award, 5-10 minutes (optional).
After the debate, there is (optionally) an award for the best poster/presentation.

GENDER INCLUSION CRITERIA

The “gender inclusion criteria” developed in the Hypatia project are relevant for the adaption of Play Decide Game & Debate and should be reflected on and discussed with the people who are offering such a class or activity. Even more they might lay the ground for the success criteria in which to measure the results of the adapted activity. The following are some examples of how this workshop addresses gender inclusivity on the different criteria levels.

INDIVIDUAL LEVEL

• Engages students to prepare themselves for the debate game.
• Involves activities that challenges the students to form opinions.
• Uses activities and approaches that incorporate a clear context so participants understand how, why and where their new knowledge may be put into practice.
• Reflects on which previous knowledge and experience participants have.

INTERACTIONAL LEVEL

• Alternates between; work in alone, in groups and a debate in plenum.
• Notes that all participants feel free to share their arguments during the debate.

INSTITUTIONAL LEVEL

• Could be set up in a differently classroom, where the students aren’t in their normal set-up to invoke thinking out of the box.
• Should include thinking about what kind of an attitude the school itself has — in the debate the teacher can discusses with the group what kind of position they have on gender.

SOCIETAL/CULTURAL LEVEL
• Will put the different opinions about gender into context

LEARNING OUTCOMES
The following learning outcomes are divided accordingly between teachers or facilitators and participants:

• Teachers or facilitators
After planning and preparing this workshop the facilitator or teacher should have knowledge of and/or be able to:
  o Adapt the activity in relation to targeting a broader group of participants.
  o Gain inspiration from the debate and incorporate this in other teaching activities.
  o Have an awareness and understanding of how to motivate girls and boys to engage in the activity.
  o Have awareness and understanding of the cultural restraints that might be part of a classroom teaching in regards to gender.
  o Realize how to counter target some of the cultural restraints in regards to gender that might be part of a classroom teaching.

• Students/participants:
At the end of the lesson participants should be able to:
  o Explore the topic of stereotypes for working in STEM in the society and knowing what thoughts and beliefs there are.
  o Recognize the opportunities to break down existing stereotypes.
  o Find arguments to support their opinions.

PARTNER DETAILS
This module was originally developed by NEMO Science Museum in Amsterdam, the Netherlands.
Contact: Meie van Laar, vanlaar@e-nemo.nl.

Cover image: Photograph: Digidaan. Courtesy of Digidaan and NEMO Science Museum, Amsterdam
GUIDELINES ON GENDER BALANCE

WHY IS IT IMPORTANT FOR PEOPLE OF ALL GENDERS TO STUDY AND WORK IN STEM AREAS?

In the coming years, with Europe’s knowledge economy developing and new technologies on the rise, skills in science, technology, engineering and mathematics (STEM) are becoming increasingly necessary in order to guarantee an adequate & professional workforce in a broad range of careers. It is therefore imperative to attract and recruit more youth to STEM study programs and ensure the diversity of STEM-trained professionals. The Vision of Hypatia is of a European society that communicates science to youth in a gender inclusive way in order to realize the full potential of girls and boys around Europe to follow STEM related careers.

Institutions and facilitators responsible for implementing science education activities, such as schools, museums and industries have a key role in this. They may influence the ways in which learners construct and negotiate their gender and their attitude towards STEM. This is why it is important to reflect on the gender and science biases we have, to acknowledge the stereotypes and make sure we do not perpetuate them in our interactions with the participants.

FACILITATING GENDER INCLUSION

In facilitating gender inclusive activities it is important to be aware of a few significant concepts.

GENDER AND SEX

Sex refers to biological characteristics and functions which distinguish between males and females: chromosomal sex, gonadal sex, morphological sex.

Gender refers to the social construction of men and women, of masculinity and femininity, which differs across time and space, and across cultures. It is a hierarchical and hierarchizing system of masculine and feminine norms.

GENDER STEREOTYPES AND SKILLS

A gender stereotype is our social perception regarding the attributes of males and females (character, abilities, tendencies, preferences, external appearance, types of behavior, roles, career paths etc.) and our tendency to relate such attributes to individuals of each sex, prior to meeting them (example of stereotype: male are more rational and female more emotional).

When we talk about gender stereotypes and science we refer to roles and abilities that are supposed to be "suitable" for males and for females in science (for example engineering and building are associated more with males than with females).

GENDER AND SCIENCE

STEM are fields of inquiry and knowledge. Like other forms of knowledge, they may include gendered dimensions. When the gender variable is not taken into account by researchers, this can influence the results: for example when medicines are not tested on both male and female. Furthermore, there is a persistent gender gap in the production system of scientific and technological knowledge and in many European countries women are over represented in biology and medical sciences while they are
under-represented in mathematics or informatics. Besides, women are less likely to reach a high level of responsibilities in sciences.

They are depicted as rational, intellectual and independent, and these characteristics are often associated with masculinity. This means that boys or girls who do not identify with such characteristics will think that STEM studies and occupations are “not for them” and avoid STEM completely. This is why it is important to present a complex and diverse image of science.

SUGGESTIONS FOR THE IMPLEMENTATION OF THE ACTIVITY

Defining, recognizing and implementing gender inclusive activities is complex and challenging and requires a constant auto reflexivity of the facilitator about his/her own gender stereotype and bias. Here are some practical indications and reflection questions to assist the facilitator in being inclusive.

INTERACTING WITH THE GROUP

- **Neutrality in assigning tasks and roles**

  *How will I assign tasks? What responsibilities will I assign and to whom?*

  Avoid assigning stereotypical gendered roles to participants that may contribute to the internalization of ‘female’ or ‘male’ identities, for example asking boys to build things and girls to take notes. Ensure that the different roles required by the activity are rotated between participants.

- **Attribution of success and failure, overcoming stereotypical responses**

  *Do male students who have failed link their failure to themselves or to external factors?*

  *Do female students who have succeeded link their success to themselves or to external factors?*

  Set a high level of expectations for both sexes. Avoid over indulging with the girls (this leads to dependency rather than independence). Encourage both girls and boys to take risks.

- **Adopt a “Wait Time” to encourage girls to speak in an environment of risk-taking boys who might respond faster than they do**

  *How attentive was I to the students’ responses? How long did I let them speak for?*

  Wait 4-5 second before calling on a student to answer a question. Delaying the answer enables all the students to respond, thus giving everyone the opportunity to come up with it.

- **Interaction with the sexes to overcome the tendency to engage with male students more than with females:**

  *Did I direct questions to boys more than to girls?*

  Be aware whether the questions are directed more to boys or to girls.

- **Unaware expression of stereotypes**

  *Did I pay attention to the students’ behaviour in relation to their expression of gender stereotypes?*
Teenagers often reproduce gender stereotypes unconsciously or in a subtle way. This might be taken as the chance to underline it and use it as a point of reflection.

**DURING A DISCUSSION**

- **Are boys more interested in building things and girls in decorating the things produced? Can you switch these roles in the activities?**
  Challenge learners to depart from their preferred interests and widen their engagement in science (many children have gender stereotypic interests that might be challenged).

- **Do you think it could be useful to introduce and discuss the concept of gender or stereotype before or after the activity?**
  Consider if a forgoing explanation of the main concepts about gender and about the terminology/concept connected could enrich the discussion.

- **While facilitating a discussion**
  Acknowledge that different learners have different kinds of prior knowledge that may be relevant in different ways. Discussion can take its point of departure in what learners already know about the subject matter.

**MEETING A STEM PROFESSIONAL**

Role models are effective in stimulating girls’ and boys’ interest in STEM. Many activities have STEM professionals as protagonist or give examples of STEM professionals. It is important that these role models do not reinforce gender stereotypes.

- **How many men and how many women appear in the example of STEM professionals I give in the activity? Are they stereotypical?**
  Keep a balance between the number of females and males as speakers or examples. Where possible ask them to talk not just about the scientific content but also about their personal life.

  Ensure that the involved science educators and scientists reflect a broad variety of personalities. Girls and boys are most inspired by role models they feel psychologically similar to themselves (as regards to origin, culture, age, etc.). Otherwise, the standards set by the other person can be seen as contrasting, and girls and boys may react against them.

- **In the activities, do I present the variety of STEM – from computer games to engineering?**
  While choosing STEM professionals and examples involved in the activity, ensure that the diversity of science is represented to the largest extent possible.
FACILITATING AN EXPERIMENTAL SITUATION

While dealing with a specific scientific content participants might not see clearly how this is related with gender balance in STEM. Hypatia activities aim to propose unexpected ways to approach science and scientific content (like chemistry, robotics or making), breaking the stereotypical perception of STEM. This serves to introduce and disseminate a different view of the world of science, unveiling different aspects with which more people — girls and boys — can identify. You can emphasize this aspect while facilitating an activity focused on scientific content rather than on gender.

- For example, an activity framing technology such as the one on wearable technologies could attract more girls than one on transport or missiles.
- Many girls feel more comfortable in a situation based on cooperation, and others even avoid competitive activities. The facilitator could present a challenge with a “story” behind and not just as a competition, or pay attention in balancing competition and cooperation in the same activity.
- Many studies show that girls learn better in an environment that is esthetically pleasing. This is why it is important to create a pleasant and esthetic environment for the activities.

USEFUL LINKS ABOUT GENDER INCLUSION IN THE CLASSROOM

HYPATIA’S THEORETICAL FRAMEWORK

The present document proposes a framework to address gender inclusion in STEM activities. It gives rise to a set of criteria for the analysis of the gender inclusiveness of existing STEM education activities, or for the design of new, gender-inclusive activities.

Theoretical Framework

GENDER EQUALITY IN THE CLASSROOM

We are frequently unaware of the manner in which we relate to boys and girls. School classrooms are no exceptions. Here is a list of points of attention and suggestions aimed at improving the degree of equality in the class in order to encourage girls and boys to pursue the fields of STEM.

Gender Equality in the Classroom
A BIT OF ADVICE FOR GOOD FACILITATION

A key element for good facilitation is the active involvement of the participants every time a concept or content is presented. Involvement means for example:

- Considering participants' personal experience as a starting point of the engagement.
- Building on their own point of view or prior knowledge.
- Embedding continuously the contributions of the participants in the process.

Facilitation is not easy; it takes practice, time and reflection! In order to transfer these concepts into practical situations — and thus to foster engagement, interaction and discussion — you can find a brief list of suggestions below. They can be helpful in developing good facilitation.

INTERACTING WITH THE GROUP

- Prepare the environment where the activity will take place in advance, organize the space according to the needs of the activity, even changing its usual structure if needed (i.e. you can move tables and chairs around).
- Make sure that all participants can see and hear well.
- Keep eye contact with the participants.
- Address participants as peers rather than as passive spectators or ignorant individuals.
- Listen to people and use their own terms.
- Use questions as much as possible — they can be a useful tool to encourage interaction among the group.
- Stimulate reflections among participants.

- If possible, ask and build on information or elements that can be discovered through direct observation.
- Engage people by linking to their personal experience.
- Encourage participants to express their opinion and elaborate their own considerations.
- During an activity, you might want to organise different group settings — work in smaller groups or in pairs, create plenary moments — to help engagement and better interaction with the experience.
- Before interacting with the participants in plenary, you might want to ask participants to discuss in small groups as a “warm up”. This helps involving the shiest people or helps everybody to feel more comfortable about the topic before sharing any consideration in plenary.
- When the discussion is set in small groups, move around the groups checking on work and discussion, and intervene — only in case of difficulties!
- In plenary, try to address everyone as much as possible, encouraging everybody to participate and engage.

FACILITATING AN EXPERIMENTAL SITUATION

- Try to make the activity as participatory as possible: every participant should have the possibility to engage directly with the experiment; avoid demonstrations.
- Do not reveal the results of the experience before the participants’ own discoveries and considerations.
- Encourage participants to make initial hypotheses/descriptions/comments about what they think would happen.
- Keep the experiment at the centre of attention and of the discussion.
• Engage learners through an alternation of manual activity, questions and discussion.

DURING A DISCUSSION

• Engage learners through a balance of open-ended questions, closed questions, discussion and exchange of opinions, etc.
• You might want to use provocative dilemmas as tools for debate. Disagreements can be valuable for analysing notions and negotiating views, use them constructively.
• Stimulate and build not only on participants’ already-acquired knowledge but also on emotions and imagination.
• Challenge the participants at a suitable level.
• Avoid:
  o A didactic approach and the assessment of participants’ knowledge.
  o Monologue.
  o Specialized terms with no reference to real objects.
  o Seeking and dealing only with the correct answers or, even worse, with the correct questions.
  o Not listening.

HOSTING A STEM PROFESSIONAL

• You might suggest to the speaker to alternate between questions and speech allowing participants to take up a more active role and prevent long talks.
• Before introducing a STEM professional, you can ask participants to share their perception about the particular profession, and then discuss it with the speaker.

• Young participants, when they have the possibility to ask free questions, often seem to be interested in the speaker’s daily personal lives, in their career path and about what they were like when they were students. You can suggest that speakers use these topics as “hooks” during speeches and conversations.

It helps if speakers bring tools or objects from their daily work with them as examples from their daily practice.

QUESTIONS: A FUNDAMENTAL TOOL FOR LEARNING

Building a relationship with an object is like ‘getting to know a new person’. Indeed, this kind of comparison can help understand a possible way of developing questions to be used in learning experiences. In the process of getting to know a person or starting a conversation we move from the basic and concrete to the abstract and more complex. Using questions in a learning situation involves similar steps: starting from basic information (usually elements that could be discovered through observation) working at levels where there is compatibility (i.e. levels where the pupils can become involved and engage through their knowledge, experiences and views), in order to proceed to the discovery of more complex information and concepts. Such an approach invites learners to search within their own repertoire of knowledge and experience for the necessary elements that would help them discover new insights, while at the same time it can operate as the foundation for the development of questions by the learners themselves.

In fact, we are not arguing here for a linear process of ‘facilitator-asks – learners-answer’; rather, we argue for a two-way-contribution process, in which both facilitator and
learners are in the position to ask and answer questions. In this sense, questions are the stimulus for initiating dialogue, the tool and not the objective. They help new knowledge to be elicited and information to be added within a free flow of ideas, leading to the broadening of understanding.

What are the types of questions that would operate as the method for eliciting information and interpretation, for initiating constructive dialogue, for developing skills and self-confidence in learners – and facilitators themselves?

First of all the basic categories:

- Closed questions – the ones that have only one correct answer.
- Open questions – those that accept more than one correct answer.

Closed questions are usually used when we seek specific information about the phenomenon/topic/exhibit/object etc. and can be further divided to:

- Questions for examination: Answering those questions requires careful examination. The answers offer the first information on the basis of which we construct more detailed knowledge.
- Questions for explanation: The answers offer an explanation – how something works, how it was created, etc. and are closely related to the information derived from the examination questions.
- Questions for comparison: These stimulate comparisons with other situations of the same type, materials, dimensions, etc. and encourage the identification of similarities, differences and connections with the learners’ personal knowledge and experience.

On the other hand, open questions encourage the expression of personal views, the employment of pre-existing knowledge of the learners, and the search for personal meanings. Discussion and open-ended questions offer learners the opportunity to pool ideas and share insights in the group followed by opportunities to develop understandings further through deploying and defending insights and opinions.

Open questions can be divided into the following categories:

- Questions for problem-solving: Those demand the use of critical thinking, imaginative thinking, hypothesis and analysis skills and ability for using knowledge for problem solving.
- Questions for prediction: The answers to those questions offer predictions in instances of changes of parameters.
- Judgement questions: Answers to those can be very personal and unique. They demand choices, evaluation of a situation, justification, etc.

You should be seeking a balance between closed and open questions. Asking only closed questions might create a feeling of ignorance among those learners who find it difficult to answer them, since they require relatively minor use of skills and more of specialised knowledge. Closed questions should be used for exploring the object and the new knowledge around it, and, in addition, offer the basis on which to ask the open questions. For any learner, answering open questions implies using their personal context to find the new information. It also enables them to use their own personal experiences, emotion, imagination and skills for meaning-making and personal interpretations.
In the philosophy of an interactive, constructivist approach to learning, the asking-answering of questions means not only the acceptance of more than one correct answer (through open questions), but also ‘allowing learners to get things wrong’, that is, not allowing a learning situation to be limited by seeking only ‘correct’ answers, or by the expectation of pre-determined outcomes. It is important that the facilitator does not jump in too quickly to correct learners, but rather uses the conflicts that arise between their different perspectives helping them to see that there are standards and that their own interpretations are not necessarily the same or as good as those held by other learners. Learning results from reference to, and drawing from, learners’ own understanding of situations, and opportunities for exploration through trial and error.

Hypatia is an EU Horizon 2020 funded project that addresses the challenge of gathering different societal actors around bringing more teenagers, especially girls, into STEM careers both in school and as a choice of learning and career in the future. It aims at changing the ways sciences are communicated to young people in and out of school to make them more gender inclusive.

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