# W-STEM: Building the future of Latin America: engaging women into STEM

598923-EPP-1-2018-1-ES-EPPKA2-CBHE-JP


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# W-STEM Training
# Retention and guidance

Universidad Técnica Particular de Loja

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# 1. Introduction: Mentoring in university environments

The 2030 Agenda for Sustainable Development (SD) and its Sustainable Development Goals (SDGs) are based on the concept of sustainability, addressing global challenges from climate change, the environment, poverty, social and gender inequalitie, poverty and peace (United Nations, 2020). Each SDG has specific goals, which require actions at all levels, involving public entities, regulators, controllers, private companies, civil society, and higher education institutions. Higher education has in its hands to generate competencies in society that allow it to face global changes (Rieckmann, 2012). According to UNESCO in Latin America and the Caribbean, only 35% of women attend university studies in STEM careers (We Need More Women In STEM Careers, 2022).

In a behavioral study that analyzes the low participation of women in STEM careers, some patterns were identified in young women related to self-confidence, stereotypes, assigned roles, among other reasons for not deciding on a STEM career (Bustelo et al., 2018). The low participation rates of girls and women in STEM are problematic both for girls and women individually and for society as a whole, causing serious inconveniences in the development of an equitable society in which they are not considered as a decision-making group, the wage gap between men and women widens, and there are fewer job opportunities (Stoeger et al., 2013). The lack of self-confidence is one of the main barriers women present in the STEM areas, either when choosing their career or during their university studies.

The importance of women's participation in STEM careers contributes to gender equity, especially in Latin American countries, so it is necessary to seek some strategies to achieve it. The W-STEM project was born precisely to respond to this global problem. W-STEM is a project financed within the framework of the ERASMUS+ Program Capacity-building in Higher Education of the European Union (W-STEM Project – Erasmus+, n.d.). The main goals of the project for 2021 are to stimulate the role of women in STEM programs, empower and ensure long-term actions that allow the project to be sustainable and the permanence of women in STEM careers with better performance and job future, for this reason, work has been carried out on a mentoring program in university settings.

Mentoring has a wide field of action, and can be specified with accompanying actions. Accompanying actions can be defined as a “relationship between a person with advanced knowledge and experience, and a younger person seeking assistance, guidance and support for their career, personal and professional development” (Fowler et al., 2007). (Psychiatry & Winter, 2003) proposed that companion relationships affect young people through three processes: (1) improving their social relationships and emotional functioning, (2) improving their cognitive skills through dialogue and listening, and (3) promoting positive identity development by presenting a role model. According to this approach, mentors who influence the improvement of more than one

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of these three processes are likely to have a greater impact on their academic and work life. Therefore, it could be said that the success of mentoring projects lies in establishing a close and lasting relationship between mentors and their mentees (Rhodes & Dubois, 2008).

The main objective of this module is to guarantee the permanence of women studying STEM careers in university environments through a mentoring program that brings together a set of actions aimed at improving self-confidence and interpersonal skills that are reflected throughout university life. and future job performance. This module is limited to mentoring in university settings, emphasizing first-year students who participate as mentees, and professors and/or seniors as mentors. The module presents a proposal to develop a mentoring program. It includes examples of good practices applied in universities that are part of the consortium of Mexico, Costa Rica, Chile, Colombia and Ecuador, based on the proposal of the W-STEM project and coupled with its context and the characteristics of each institution and country.

The module is structured as follows: we will start by defining what a mentor and mentees are; later, the origin of mentoring over time will be discussed; then the roles will be defined, the skills that mentors must-have, and the types of mentoring that exist; Subsequently, it will be shown how to develop a mentoring program with a description of the stages that must be fulfilled and the mentoring program that has been proposed in the WSTEM project. Finally, the mentoring network will be mentioned, and case studies will be shown in each of the countries participating in the project and in-depth readings.

## 2. Definitions: mentors, mentees

In order to unify the terms with which the course will be developed, we will define the following terms:

Mentoring: It is a relationship of accompaniment and guidance in educational environments, which develops between a person with experience (mentor) and another person who wishes to acquire that experience (mentee).

Mentor: It is the person who will carry out the accompaniment during the process, it can be a professor, or a student of the last semesters of the career.

Mentee: It is the student who will receive the accompaniment during the mentoring program.

## 3. Mentoring evolution timeline

In this section, we will review how the topic of mentoring has evolved over the years. We will start by defining the word mentor.

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Etymology: The word mentor originates from Greek mythology. Specifically, when Ulysses entrusted the education of his son Telemachus to a mentor. According to the story, a mentor personified Athena, the goddess of wisdom.

**Plato and Aristotle:** By the fourth century, the purpose of mentoring was focused on emancipation and not so much on indoctrination. With this, they wanted to contribute to the development of another person in order to enhance their learning in a self-directed way. For this century, an example of mentor and mentee is that of Plato and Aristotle, respectively.

**Modern age**: By the 18th and 20th centuries, with the Industrial Revolution, the mentor went from being a social protagonist to a coach, a teacher in an institutionalized educational system.

**Education:** With the background of the Modern Age, at the end of 1990, there was a boom in mentoring programs for teachers in training, to improve integration or academic success through peer mentoring systems.

**Digital age – emerging education:** On the other hand, with the massive use of the Internet, mentoring processes were changing and becoming part of the digital age at the beginning of the 21st century. Mentorships can be distributed and developed online. In addition, in recent years, mentoring has begun to be one of the protagonists in teaching and learning methods. Mentoring continues to grow and evolve according to the transformation of education and communication environments.

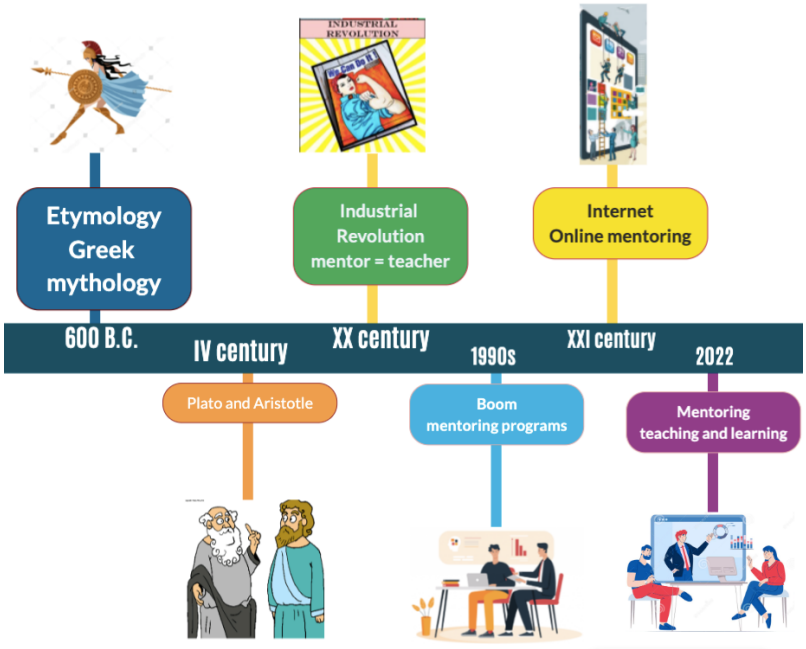


*Figure 1. Mentoring evolution timeline.* *(Observatory of Educational Innovation, 2017)*

**Recommended activity:** If you wish to deepen on this topic, we suggest reviewing the document *Mentoring del Observatory of Educational Innovation.*

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# 4. Mentor roles

A good mentor must be in context, which implies that each mentoring case requires a specific mentor profile and a different type of relationship between mentor and mentee.

Following, some of the roles found in the literature are identified below. Figure 2 describes the proposed roles (Butler & Cuenca, 2012).

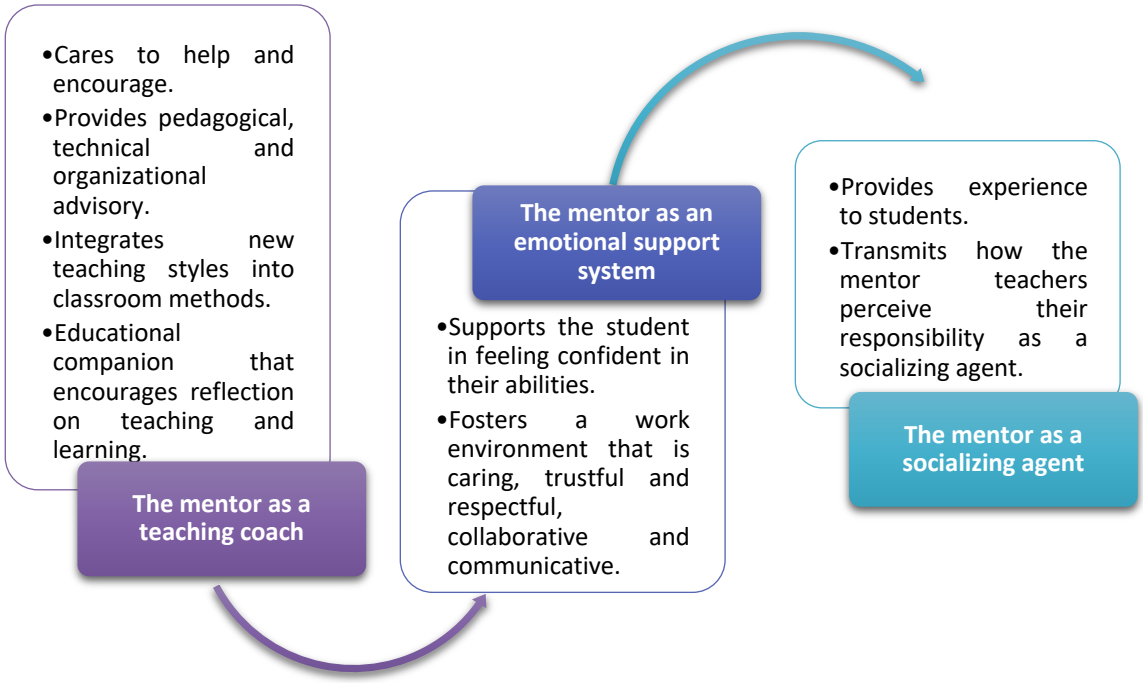


*Figura 2. Mentor roles.* *(Butler & Cuenca, 2012)*

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Some of the roles proposed in the study by (Verdesoto & Chenche, 2018) are described in Figure 3:

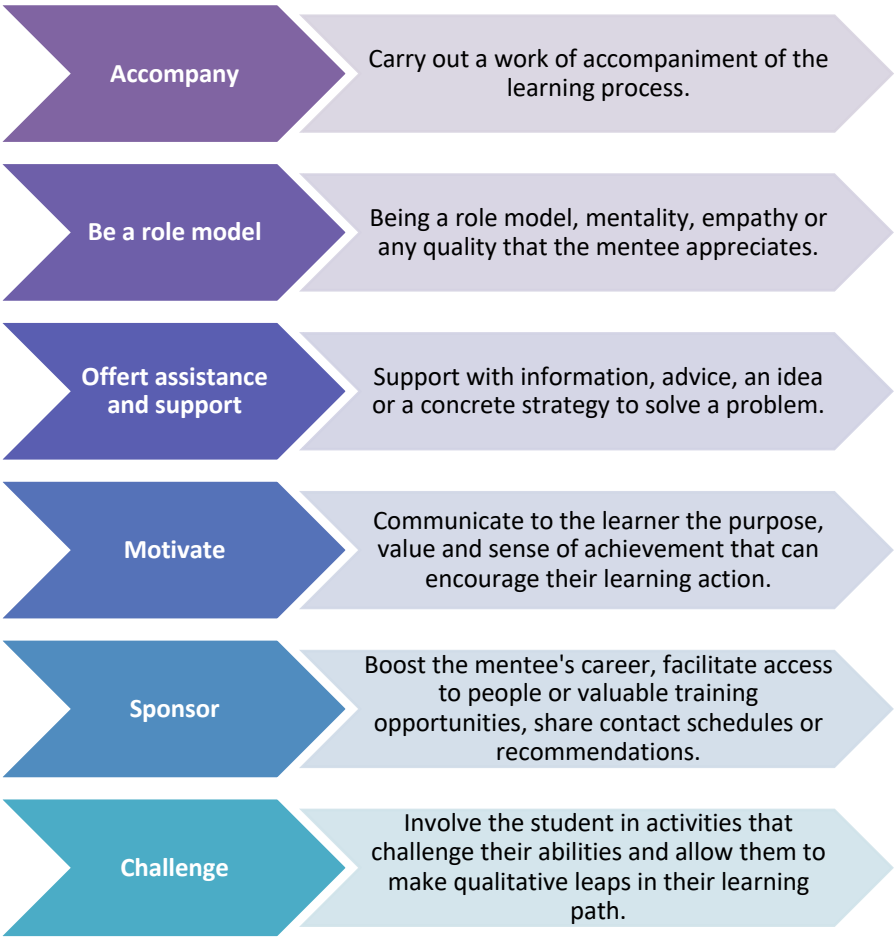


*Figure 3. Mentor roles.* *(Verdesoto & Chenche, 2018)*

## 5. Mentor skills

To work as a mentor it is very necessary to have skills that allow you to achieve the objectives with the mentees, for this I invite you to analyze the following proposals. According to (Manzano et al., 2012), the key skills of a mentor are those mentioned in Figure 4:

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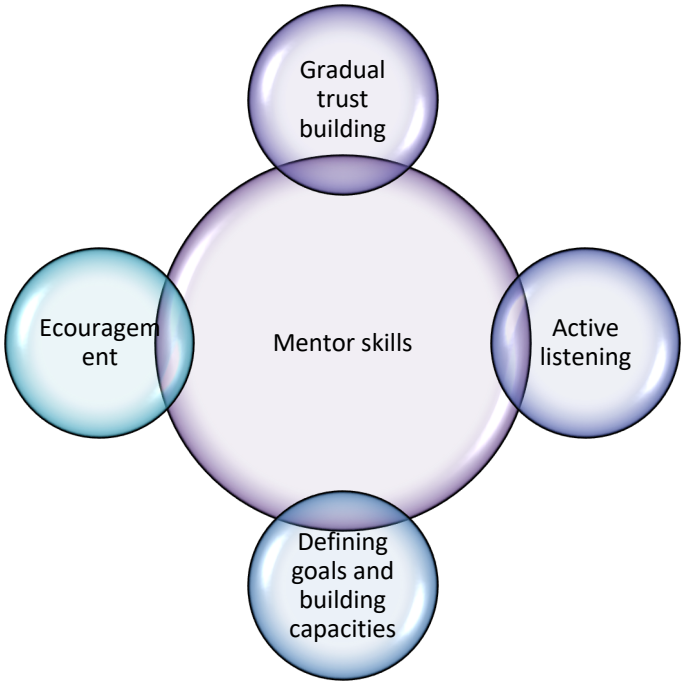


*Figura 4. Mentor skills.* *(Manzano et al., 2012)*

Vélaz de Medrano (2009) indicates that there are attributes of the mentor that can be observed in most successful mentoring practices such as those mentioned in Figure 5:

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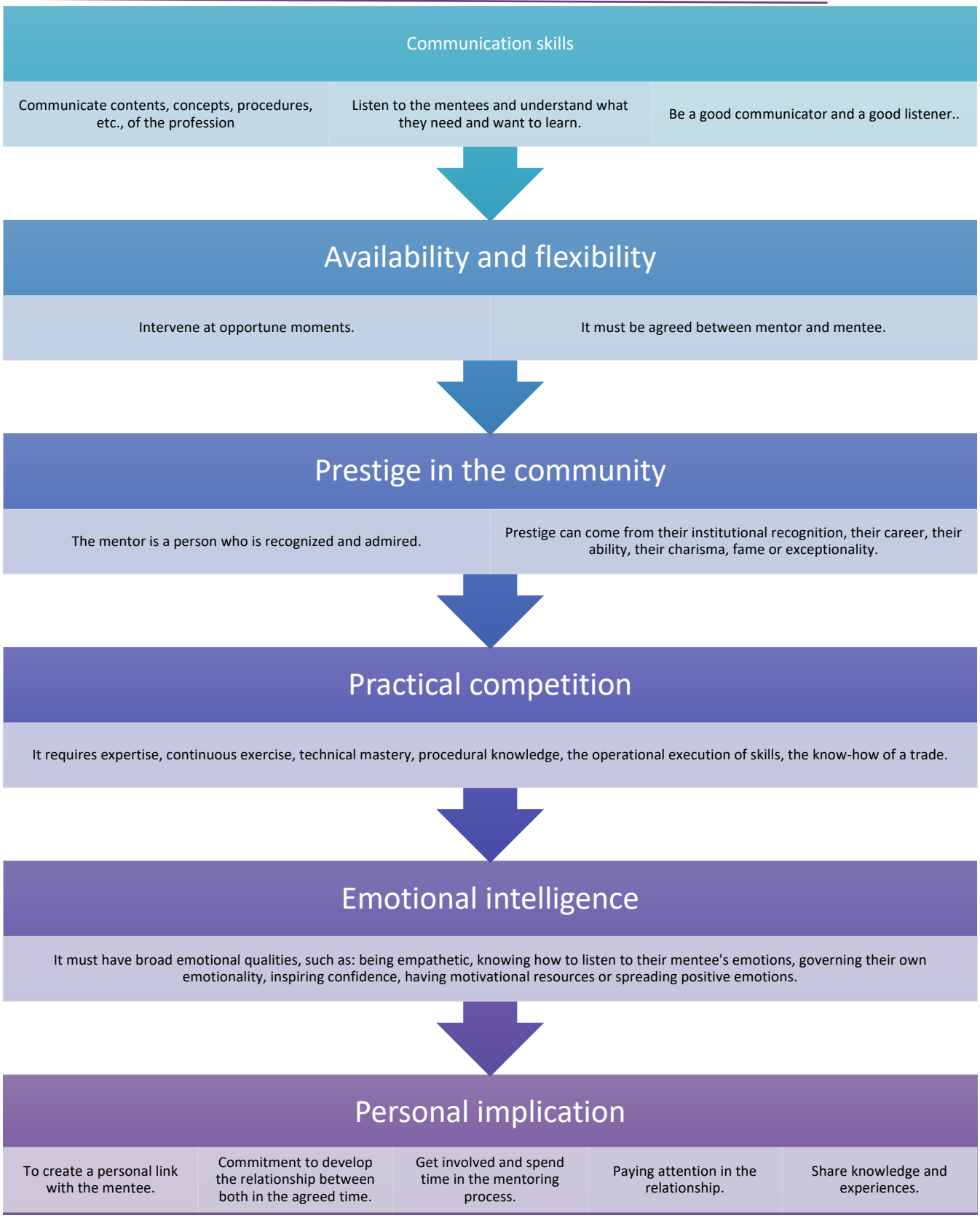


*Figure 5. Mentor skills.* *(Vélaz de Medrano, 2009)*

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# 6. Types of mentoring

In this section we will see that there are different types and modalities of mentoring. The different types of mentoring have been summarized in the figure below.

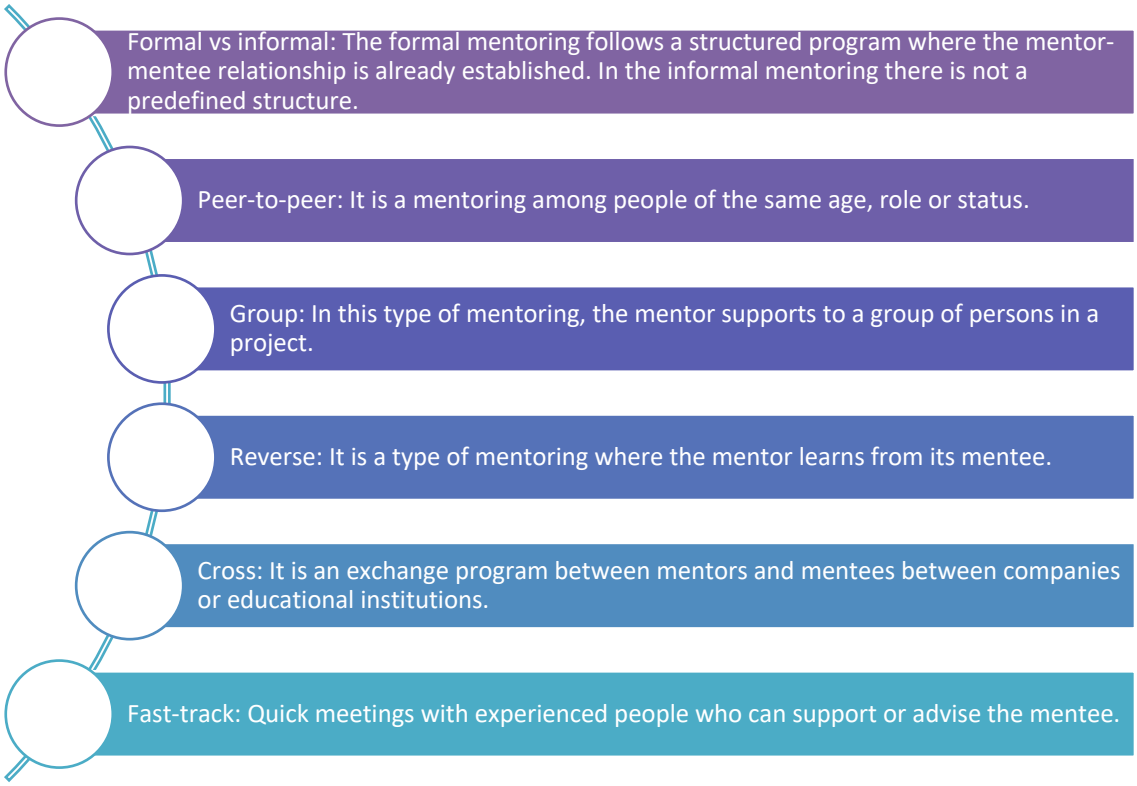


*Figure 6. Mentoring types.*

**Activity:** Based on the mentioned mentoring types, we suggest you choose 3 of them and give an example for each one. Please, place your answers in the format indicated at the following padlet: Tipos de mentorías.

Below we will briefly review mentoring in higher education and e-mentoring.

Mentoring in higher education has been changing over the years. The term mentoring has been taking on different definitions. In 1978, Levinson et al. defined a mentor as a teacher, counselor, or sponsor, which allowed the term to be left open to a personal or professional connotation. Later, Ragins (1997) described a mentor as a person with advanced experiences and knowledge, who are willing to support their mentees in their professional development.

Although they referred only to male mentors in the early years, various reasons have been analyzed that drive formal mentoring practices in higher education that already include women as mentors: supporting training processes, promoting aspects of identity (individual or group), mitigating desertion, among others.

Some aspects of mentoring in higher education can be seen in Figure 7:

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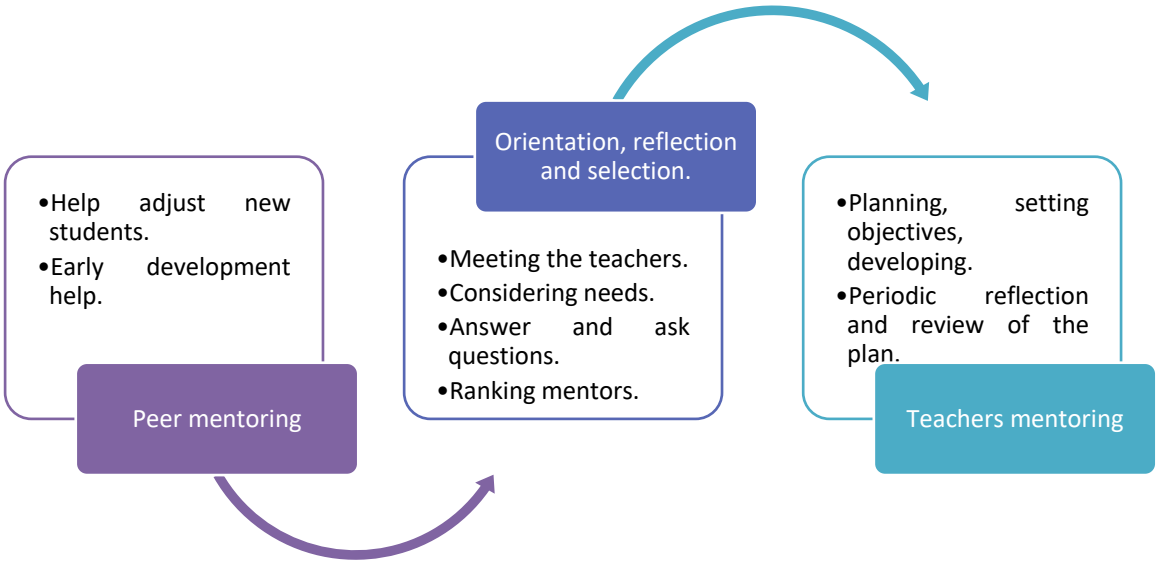


*Figure 7. Mentoring in higher education.*

However, despite not having a clear definition of the term mentoring and few models to carry it out, another type of mentoring has been making its way into university institutions. We refer to e-mentoring. E-mentoring, online mentoring, telementoring, or electronic mentoring refers to email or online software to support a mentoring relationship.

For the development of an e-mentoring, the following aspects must be taken into account:

- Use of social networks such as Youtube, Facebook, Instagram.
- Use of cloud platforms, synchronous chats, email.
- Mentor training for the use of tools, online skills, social and cultural teaching.
- Platforms, which must be adjusted to the needs and resources available at the institutional level.

In Figure 8, we have summarized some of the benefits of e-mentoring.

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*Figure 8. E-mentoring benefits.*

## 7. Mentoring stages: Planning-Developing-Evaluation

To better understand mentoring in the context of higher education, a process is proposed that includes three main phases: (i) before, (ii) during and (iii) after, each phase includes its own activities, as shown in the figure and described below:

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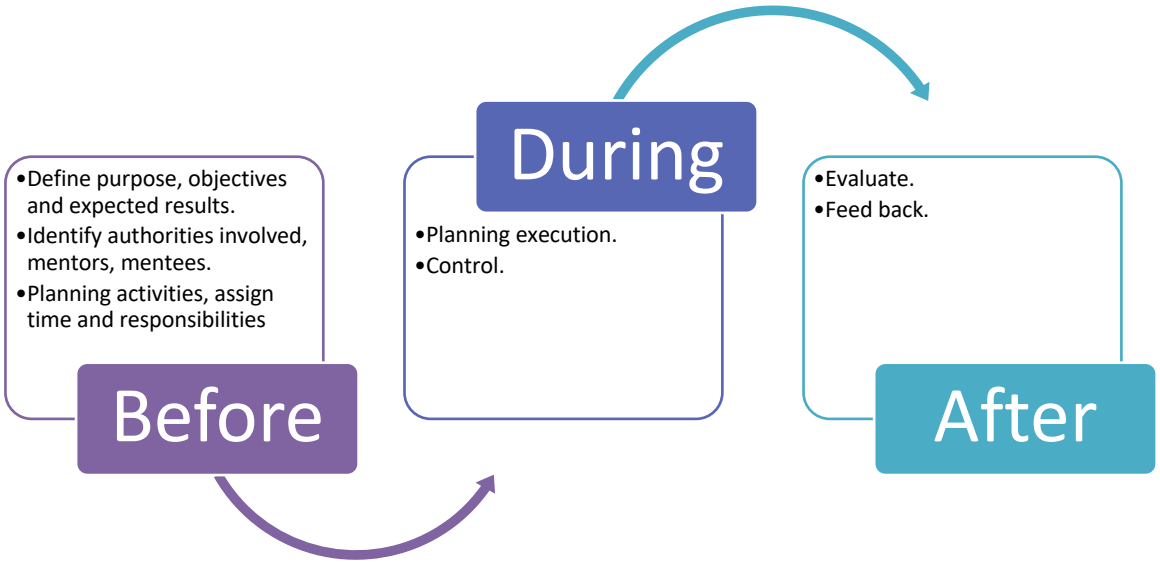


*Figure 9. Mentoring phases.*

## a) Pre-mentorship phase

For the preliminary phase, the following activities are proposed:

1. **Define purpose, objectives and expected results:**

(University of Mumbai, s/f) mentions that some of the goals and objectives of educational mentoring are:

- Help the student to understand their potentialities, strengths and limitations.
- Help the student make educational plans according to her abilities, interests and goals.
- Allow the student to know in detail the academic offer.
- Help the student make satisfactory progress in university subjects.
- Help the student to adapt to the educational institution, its rules, regulations, social life related to it.
- Help the student develop good study habits.
- Help the student to participate in educational activities outside of class in which she can develop leadership and other social qualities.

2. **Identify the parties**

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Those involved in a tutoring process are mainly mentored students (mentees), teachers with the role of mentors, the educational institution that provides the context, means, regulations and other elements to execute the mentoring and in some cases external tutors from outside the educational institution.

3. **Plan activities, assign times and responsibilities**

Planning implies defining the activities that will help us achieve the previously defined purpose or objectives, the sequence of execution, the duration times and those responsible.

Some of the activities or strategies to be used by the mentors proposed by (Observatory of Educational Innovation, 2017) to develop their work are mentioned below:

- **Modeling.** It consists of teaching by example, when the mentor does what the student wants to learn. This action can be a didactic simulation created specifically to model the student's behavior, or the mentor can invite the mentee to observe how they perform in a real academic or professional context.
- **Autobiographical narration:** When the mentors tell their own anecdotes or cases that they know personally, the mentee learns to face specific problematic situations. They can be success stories or, very often, failures. These stories often illustrate a lesson or action principle applied to real situations.
- **Active listening:** Mentors can be very helpful simply by listening to the doubts, emotions or situations shared by the student. They do not necessarily have to offer advice. Very often, the quality of active listening and empathy can create a communicative environment in which the learner becomes aware of her situation, vents, regains self-esteem, and feels understood and supported.
- **Maieutics:** Following the Socratic method, mentors dialogue with their mentees by asking them questions, seeking that the mentees question their own initial prejudices and generate their own learning in the direction that the expert leads them.
- **Feedback to the participant:** Mentors carefully observe the performance of the students in a specific activity and indicate what they could improve or validate what they are doing well. Unlike the evaluation rubric that a teacher normally uses, mentors evaluate the performance of their mentees in the same learning process, but they do not use a previously established sequential line of tests (exams, homework, etc.).
- **Patronage:** Mentors make their personal contacts or resources available to mentees to provide them with opportunities to advance professionally or enhance their learning. Some examples of patronage would be connecting mentees to a project where they can develop their skills, introducing them to

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important people for their evolution, providing them with tools or workspaces, or sharing educational material.

- **Personal Learning Environments (PLE):** Comprises the sources, activities, applications, places or people that make up the network of resources through which a person learns. A valuable strategy for mentees is to access the mentor's own bank of learning resources. For this reason, one of the most valuable practices of mentors is to share, for example, the books that have influenced them, the websites they visit, the scenarios where they learn the most, the digital applications they use, etc.

## b) Phase during mentoring:

- **Run planning**

The execution is the implementation of the planning, the activities, times and responsibilities defined in the previous phase. Some resources that can be useful in this phase are a work schedule, keeping a record of the mentoring meetings, technological tools , know the institutional regulations, the context of the mentee academic cycle that he attends, subjects that he takes, teachers with whom he is interacting.

- **Monitoring and control**

Monitoring is an aspect that must be carried out throughout the entire mentoring process. It consists of collecting, measuring and distributing information related to performance, and evaluating measurements and trends that will allow improvements to be made. Continuous monitoring allows knowing the status of the mentoring process and identifying areas that may require special attention. The control includes the determination of preventive or corrective actions or updating the planning and monitoring of the activities. In general, monitoring and control deals with:

- Compare actual performance to planned performance;
- Evaluate performance to determine the need for preventive or corrective action and, where appropriate, recommend those that are considered pertinent;
- Identify new risks and analyze, review and monitor existing project risks, to ensure that risks are identified, their status is reported and appropriate risk response plans are implemented;
- Maintain a database of results obtained and other documentation generated;
- Provide the necessary information to support the status report of the process, progress measurement, budget status, among others
- Monitor the implementation of approved changes when they occur.

## c) Post-mentoring phase

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1. **Evaluate**

The open and flexible nature of the mentor-mentee relationship makes it challenging to assess the quality of mentoring. Additionally, there are multiple forms and mentoring modalities, each requiring its own consistent assessment strategy. The following are some of the assessment procedures that are frequently used in tutoring.

**Questionnaires.** Closing questionnaires are becoming more prevalent in professional tutoring services. Questionnaires can include closed questions (Likert scales, etc.), which provide a comparative standard between each tutoring service, and open questions, which reveal the importance and value of the experience for the participants. Although it is usually administered at the end of the service or experience, it can also be used as a diagnostic tool at the beginning of the relationship or as a continuous feedback procedure in the process.

**Teaching techniques.** Some didactic models of instruction and various pedagogical techniques can help mentors in their practice, while also providing assessment techniques. For example:

1. **PBL (Problem-Based Learning),** in which the mentors, starting from a problem posed to their mentees, use their experience to solve it. The final product, built along the way, is the best evaluation test.
2. **The case method.** The mentors expose a case involving a dilemma, decision making. The student(s) must take a position in the case and argue for its merits relative to other possible decisions. Mentors lead the conversation, focus analysis, add information, affirm knowledge. The relevance of the decisions made by the mentees, their argumentation, the resources at stake in the discussion can provide evidence to assess the quality of their learning.

**Learning portfolio.** This is the most recognized procedure in the recent literature on mentoring, the one that perhaps best expresses and reveals the learning obtained in the mentor-mentee relationship. There are several types of portfolios, but, in essence, they are organized collections of documents, products, evidence, works or any other resource that allows students to show what they were capable of doing and reflect on their own learning path. In the digital age, a practical tool for this would be through the production of a website (easily self-designed, such as the Wix platform), the creation of a blog or the organization of an electronic portfolio in Google Drive or equivalent technology.

**Interaction analysis.** One of the most significant variables in the mentor-student relationship is their interaction: How frequent is it? How do they take turns talking? What kind of relationship is created? What do they share in this interaction? Are there

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various interaction analysis tools that can answer these questions? Some focus more on an in-depth analysis of the interaction in the case of multiple or distributed tutoring, such as sociograms. However, others derive from discourse analysis (Scheglo, Goodwin) and serve to reveal the qualitative meaning of the communication. These conceptual and methodological tools can be applied to a recorded mentoring experience (online videos of the meetings) or to digital platforms that collect the interaction of the participants, such as the discussion forums on Blackboard. The purpose of implementing them is to reveal or measure the value of this learning experience.

# 8. WSTEM mentoring networks

The Mentoring Network made up of the universities participating in the WSTEM project has been organized with general parameters in such a way that it can be adapted to the reality of each country and each university and is detailed below:

### Proposal

The objective of the Mentoring Network is to empower women and encourage their active participation in STEM careers, thus, the following specific objectives must be met: a) train MENTORS (who can be teachers or students of upper semesters, whether they are men or women) to involve them in improving the participation of women in STEM careers and carry out mentoring with a gender focus, b) accompany female students in STEM careers and improve their student participation, c) generate indicators that allow to characterize the young women who choose STEM careers, and d) generate effective proposals to increase the interest of girls and young people in STEM careers.

To develop this proposal, the following activities are proposed:

1. Training of Mentors and Mentors who can be students of the upper semesters and teachers.

In order for mentors to carry out work focused on gender, it is essential that they are aware of issues related to the history of feminism and the struggle for rights in general terms, women's rights, gender violence, prevention, in such a way that there is an empowerment with the topics to be addressed focused on university students:

a. Women's empowerment, I Workshop on gender violence IES - University Network of Gender, Equity and Sexual Diversity (udual.org)
b. Inclusive language, the following course is suggested: United Nations: Gender Inclusive Language
c. Leadership.

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2. The training of the mentors will be carried out with the support of the W-STEM project, to later deliver a certificate.
3. For male/female students who work as mentors, it is suggested to look for a stimulus that will depend on each university, ideally it would be a scholarship. The participation of upper semester students is recommended for the following reasons:

☺ Generate a better relationship between young women of closer ages that guarantees effective mentoring.
☺ Scholarships can be managed for the Mentors, at least in private universities, or some reward for their work, with which the fulfillment of the tasks can be guaranteed.
☺ Empower young future professionals about the importance of their participation in STEM careers by fostering their leadership.
☺ Work certificates can be generated that will be used to apply for postgraduate scholarships.
☺ Likewise, they must be asked to meet some requirements of student achievement, and also of ethical behavior, in such a way that they can become a reference for first-year students.

4. The mentors will work with a group of mentees, to avoid personalized contact.
5. The MENTORS are suggested to be only female students, since this mentoring seeks precisely to improve the participation of women in STEM careers.
6. The accompaniment and mentoring that will be carried out will be focused on the empowerment of women, inclusive language and leadership.
7. Once the working groups have been organized, fortnightly meetings are suggested, in such a way that adequate and timely mentoring is generated.

## Proposed duration

Mentoring must be applied during the first year of university for young women in STEM careers.

## Proposed evaluation

It is necessary to evaluate the application of the program, apply satisfaction surveys to the students before and after the mentoring process and in this way improve the processes continuously. It is suggested to apply the following questions applying a Likert scale:

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1. When applying, students will be asked the following:
    a. Do you have any previous mentoring experience?
    b. What do you expect during this mentoring program?

2. When starting and ending the mentoring
    a. Do you consider it important to work on promoting the participation of women in engineering careers?
    b. Do you think that women who study engineering careers need mentoring?
    c. Do you consider it important to improve your skills to work in groups in which the majority are men?

### Proposed indicators

To collect information with indicators for all universities in Latin America (LA), it is suggested to carry out the surveys proposed in the SAGA project on drivers and barriers in STEM science and engineering careers: Working Paper 4 in the student section: Working Paper 4 en la sección de estudiantes: The SAGA Survey of Drivers and Barriers to Careers in Science and Engineering; SAGA (STEM and Gender Advancement) working paper; Vol.:4; 2018 - 266146eng.pdf (unesco.org).

The surveys can be found at the following link: Encuestas

## 9. Support tools for mentoring

To carry out the mentoring, it is possible to rely on ICTs (Information and Communication Technologies), taking into account that this has become a necessity for any field because we find ourselves in an interconnected world.
Most of the activities can be managed by applications or cloud platforms. Table 1 presents the activities and types of tools available:

*Tabla 1. ICT tools to support mentoring.*

| Activity | Tools |
|---|---|
| **Collaborative (Documents)** | (1) Office 365<br>(2) Google Drive<br>(3) Dropbox |
| **Collaborative (Interactive boards)** | (1) Miro<br>(2) Jamboard<br>(3) Padlet |
| **Communication** | (1) WhatsApp<br>(2) Telegram |

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|---|---|
| **Training** | (1) Virtual Learning Environments - LMS<br>(2) Zoom<br>(3) Microsoft Teams<br>(4) Google Meet |

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