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Work package n°3 - Training: M-STEM Curriculum and Training Contents.

D7: Development of Chapter 6: Career pathways in Stem - Career opportunities for young students

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1. Introduction

1.1 Defining STEM careers

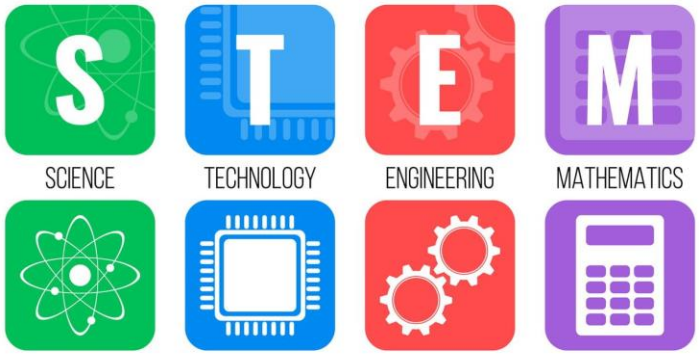
Deciding on a future career is not easy. There is a wide variety of degrees and career opportunities, which makes it difficult to choose. However, STEM careers can offer high employability, good conditions and development opportunities.
According to the World Economic Forum's *Future of Jobs Report 2023*, 25% of current jobs will change in the next five years, largely due to technological transformation. Hence, studies linked to Science, Technology, Engineering and Mathematics are gaining prominence and are becoming the professions of the future.

When people talk about STEM careers, they are referring to the acronym for Science, Technology, Engineering, and Mathematics (STEM). Therefore, this growing sector encompasses studies that include skills and knowledge in one of these disciplines.

By subject area, some of the most popular STEM careers are:

- Sciences: Physics, Chemistry, Biology, Biotechnology, Astrophysics, Medicine, Dentistry, etc.
- Technology: Computer Science, Telecommunications, Systems Analysis, Robotics, Web Development, etc.
- Engineering: Electronics, Electrical, Mechanical, Architecture, etc.
- Mathematics: Mathematics, Economics, Statistics, etc.

However, in the labour market, there is a constant need for professionals. As a result, new STEM careers are appearing every year in addition to the classic ones. These are programmes related to data processing (Big Data), cybersecurity, nanoscience, virtual and augmented reality, the Internet of Things (IoT), bioinformatics, genetics, food science, environmental sciences and astronomy, among others. And, according to the U.S. Bureau of Labor Statistics, in the field of Data Science alone, the number of jobs will increase by 35% between 2022 and 2032.



1.2 Importance of STEM in today's society

STEM education is essential for several reasons. Firstly, STEM careers are some of the highest paid and most in-demand professions worldwide. Currently, jobs in these fields are growing at a faster rate than the average rate of employment growth, a trend that will undoubtedly continue over the next few years. This means that there is a high demand for skilled workers in these fields, and students who pursue STEM studies are more likely to find satisfying and, above all, well-paid jobs.

Secondly, STEM education also aims to address the long-standing *gender* gap in these fields. At present, the representation of women in STEM careers is low, but gradually increasing quotas are being achieved. in this regard, there are numerous campaigns actively encouraging girls from an early age to pursue STEM studies, with the aim of encouraging them to choose careers in these fields in the future, thereby increasing gender diversity within these sectors.

Finally, STEM education equips students with skills that are transferable to other areas of life**.** The problem solving, critical thinking and analytical skills that students learn in STEM education can be applied to many other contexts and situations, including non-STEM fields. These skills prepare students for lifelong learning and success, regardless of the career they choose.

2. General Context of STEM Careers

2.1. Evolution and relevance.

Studies and forecasts are unanimous: in the European Union, the demand for professionals in technical and scientific careers exceeds the supply. And this gap is expected to widen substantially in the coming years. On the other hand, the vocation of teenagers for STEM subjects (science, technology, engineering and mathematics) is decreasing. This means that the problem of labour demand will only get worse in the future. But this is not the only difficulty. The basis for economic, industrial, technological and social development depends on the breakthroughs discovered by future STEM graduates. It is necessary to study the starting point situation and look for causes and solutions to solve the problem posed by the STEM paradox: why there is a constant drop in interest in STEM studies among teenagers, if the future employment of these careers is one of the most promising and is expected to improve.

2.2. The need for these careers in the global and local market.

Europe is in the midst of a labour market paradigm shift. The globalisation of markets is taking hold and requires new labour skills. Automation, Industry 4.0, the development of telecommunications, big data, the shift to clean energy, among others, are realities of today's society, on which the well-being of modern society depends. But they are also the trends that will underpin economic growth in the future. All this must come hand in hand with STEM workers. The greatest employment opportunities for recent graduates are among those with a higher education degree1 . This is a trend that has continued over the last decade and is expected to continue in the medium to long term future. The more educated the population is, the higher the employability and activity rate and the lower the unemployment rate. This happens regardless of the age and gender of the person and it is in the STEM professions where the employment rate is highest. The European Commission has warned of the huge demand for job vacancies in science and technology. The forecast ranges from 300,000 unfilled positions in 2020 to 500,000 or even 900,000 in ten years, where the main reason is the change in the production model. The intensification of automation, the European Union's "reindustrialisation" strategy, the retirement of the "baby boom" generation and the great difficulty European companies have in attracting talent are some of the reasons for this. The main challenge facing the EU is the shortage of professionals in this sector. Students' loss of vocation for STEM subjects is causing them not to decide to study or to drop out of such careers.

2.3. Projected growth in STEM sectors.

In recent years, society has undergone dramatic changes in the way we live, work and interact with the world. This is the beginning of the new Age of Digitalisation. At the Davos Forum1 (2016), the beginning of an overwhelming change called: Revolution 4.0 was established. This new revolution is based on digitalisation and is here to stay. It features merging technologies, which are blurring the boundaries between physical, digital and biological spheres. This revolution encompasses massive advances related to artificial intelligence, nanotechnology, 3D printing, robotics, biotechnology and genetics. All this has a strong impact on society and the economy of a country, as it modifies the business models of companies, directly influences people's way of life, the world of medicine, among others. This new scenario requires a society that is prepared for change and that is able to adapt to change with the greatest flexibility.

As Echevarría and Martínez state in their article, according to Schwab, the human being can be redefined due to the strong changes that are emerging in society and in the world,

as both the needs and the way of living are now conditioned by technology and digitalisation. "The amazing innovations brought about by the fourth industrial revolution, from biotechnology to artificial intelligence, are redefining what it means to be human" (Benito Echevarría, 2018).

Changes in human beings will affect various aspects of our lives, from the way we relate to others, to ourselves, to technology, to the tasks we have to do that will be accompanied by technology from the moment we wake up; even the longevity of people will also be related to technology.

Moreover, it seems that today's technological devices are replacing privacy with conviviality. If you look at today's society and compare it with the society of 10 years ago, you can see that life is currently driven by the media and digitalisation. 100% of the population has an electronic device through which they interact with society. This is increasingly the case from a very early age. Nowadays, people are practically born with the necessary skills to be able to use a digital device.

Studies say that despite the social and industrial change brought about by technology, jobs will be created that are related to the interaction between people and machines. It is all related, because machines do not build themselves, so it is people who have to develop sufficient skills to be able to build machines. This leads to the conclusion that has been speculated so far, that jobs are going to evolve and that the demand for technological profiles is going to increase.

What is going to happen in the coming years in Western countries is that jobs are going to be modified, the way of working is going to change and merge with the way of working, and the way of working is going to change.

The development and capacity of artificial intelligence can replace a human being, just as robots have done so far in many fields such as medicine, for example. So far, robotics has been used for surgery, or for logistics, bank branches, among others. On the one hand, robotics and the increase in the number of jobs without the need to train personnel is changing the world of work. Not only are they replacing low-skilled jobs, but they are replacing very specific and skilled professions, such as surgeons. More and more operations are being performed by robots, and the most important and shocking thing is that patients seem to trust the machines and are not worried about the feeling of not being treated by a human.

3. Academic Outlets in STEM

3.1. Specialisation options

STEM (Science, Technology, Engineering and Mathematics) degrees offer multiple academic opportunities for those who wish to deepen their knowledge or specialise in emerging areas. These options allow professionals to keep up to date, advance their careers and contribute significantly to scientific and technological development. The main specialisation options and the most relevant emerging areas are listed below.

3.1.1. Postgraduate and Master's degrees.

Postgraduate and Master's programmes are a common way to specialise after obtaining a university degree in STEM. These programmes allow:

- Broaden knowledge in specific areas such as advanced engineering, computer science or applied mathematics.
- Access highly skilled roles in industry or academia.
- Develop practical skills through projects and collaborations with companies.

In Europe, programmes such as the master's degrees in Biomedical Engineering, Data Science and Robotics stand out. In addition, international scholarships, such as Erasmus Mundus, facilitate the mobility of students interested in programmes of excellence.

3.1.2. Academic research.

For those who wish to contribute to global knowledge, academic research is a crucial outlet.

- Doctorates: These are the gateway to research, allowing students to work on cutting-edge projects funded by universities, governments or private institutions.
- International projects: Initiatives such as the Horizon Europe programme promote collaboration in areas such as quantum physics and biotechnology.

The impact of this specialisation is visible in innovations such as messenger RNA vaccines or advances in sustainable materials.

3.1.3. Advanced courses and specific certifications.

The rapid evolution of STEM technologies has driven the demand for specific technical courses and certifications.

- Short courses and bootcamps: In fields such as programming, cybersecurity or data analysis, they offer intensive training.
- Recognised certifications: e.g. AWS Certified Solutions Architect (cloud technology) or Microsoft Certified: Data Analyst (data analytics).
- Advantages: They allow for rapid integration into the labour market or the updating of knowledge in a constantly changing environment.

3.2. Emerging areas:

Emerging areas in STEM represent the future of innovation and sustainable development. Among the most prominent are:

3.2.1. Artificial Intelligence and Big Data.

Artificial intelligence (AI) and big data analytics are revolutionising entire industries.

- Key applications: process automation, personalisation in marketing, epidemic prediction and autonomous driving.
- Academic opportunities: Master's degrees and certifications in Machine Learning, predictive analytics and AI ethics are in high demand.

3.2.2. Biotechnology.

Biotechnology combines biology, chemistry and technology to create innovative solutions in health, agriculture and the environment.

- Key developments: Genetic treatments, bioplastics and bio-manufacturing.
- Academic specialisation: Masters in molecular biotechnology, bioinformatics or biomedicine offer advanced training in these disciplines.

3.2.3. Renewable Energies.

With the global transition to a sustainable future, renewable energies are a key pillar.

- Growing fields: wind power engineering, solar photovoltaics and energy storage.
- Training programmes: Masters in renewable energy and environmental sustainability are designed to prepare experts to lead this change.

Academic outlets in STEM not only offer a wide range of opportunities for specialisation, but also equip professionals to tackle the most pressing global challenges. Whether through

postgraduate degrees, research or technical courses, these options are key to staying ahead in an ever-changing world.

4. Career opportunities in STEM

STEM (Science, Technology, Engineering and Mathematics) degrees offer a wide range of career opportunities thanks to their relevance in digital transformation, sustainability and technological advances. Graduates from these fields find job opportunities in strategic sectors, highly sought-after professions and opportunities for global entrepreneurship.

4.1. Main sectors of employment:

4.1.1. Technology and software.

Technology and software development are pillars of the digital economy. This sector encompasses areas such as programming, cybersecurity, artificial intelligence and mobile app development. Technology companies, from giants like Google to emerging startups, are looking for talent capable of innovating in algorithm design, data analytics and cloud solutions.

4.1.2. Health and biotechnology.

The healthcare and biotechnology sector has grown exponentially, driven by the need for innovative medical solutions, such as messenger RNA vaccines. STEM professionals work in biomedical research, medical device design, genetic engineering and clinical data analysis, contributing to global wellbeing.

4.1.3. Energy and environment.

The transition to clean energy has positioned renewables as a key sector. Engineers and scientists are developing solar, wind and energy storage technologies, as well as working on climate change mitigation and sustainable resource management.

4.1.4. Engineering.

Engineering encompasses branches such as aerospace, civil, industrial and robotics, and is central to infrastructure, advanced manufacturing and transport. These professionals design and optimise technical solutions to complex problems in sectors such as construction and automation.

4.1.5. Science education and outreach.

The growing importance of science and technology literacy has driven the demand for teachers and communicators. STEM professionals teach in universities, schools or through digital media, helping to educate future generations in key disciplines for progress.

4.2. Most in-demand professions:

4.2.1. Data Scientist.

Data scientists are essential for analysing large volumes of information and extracting insights applicable to business, science and public policy. According to the World Economic Forum's *The Future of Jobs 2023* report, this profession is leading job demands in technology and financial sectors.

4.2.2. Software engineer.

Software development and optimisation are critical skills in technology companies and traditional sectors undergoing digitalisation. From software architects to full-stack developers, this profession stands out for its flexibility and high remuneration.

4.2.3. Bioinformatics, among others.

The intersection between biology and technology has given rise to the bioinformatician, who analyses genomic data and designs algorithms for medical research. This profile is essential for areas such as biotechnology and pharmacology.

4.3. Global opportunities.

The global STEM market is large, with high demand in countries such as the United States, Germany and Japan, where the technology and industrial sectors face a shortage of skilled professionals. Programmes such as STEM visas and international collaborations open doors for professionals interested in working abroad.

4.4. Entrepreneurship in STEM.

Entrepreneurship is another key career path. Many STEM graduates found start-ups in areas such as artificial intelligence, biotechnology and renewable energy. Technology incubators and accelerators, such as Y Combinator or Techstars, provide financial and strategic support to these projects.

5. Key Competencies for STEM Success

The STEM (Science, Technology, Engineering and Mathematics) field is characterised by constant evolution, driven by technological and scientific advances. To succeed in this field, professionals must cultivate a combination of technical and soft skills, as well as an attitude of adaptability and continuous learning. These key competencies are detailed below.

5.1. Technical skills (hard skills).

Technical skills are specific and measurable competences that apply directly to the knowledge of tools, languages, technologies and processes within STEM disciplines. These skills are essential because they enable professionals to develop, implement and optimise practical solutions in a highly technical environment. Some of the most important include:

- Programming and software development: Knowledge of programming languages (such as Python, Java, or C++) is indispensable for professionals working in areas such as software development, artificial intelligence or data analysis.

- Data analytics: The ability to work with large volumes of data (big data), use it to create predictive models and draw relevant conclusions is crucial in areas such as data science, engineering and biotechnology.
- Knowledge of specialised technological tools: The mastery of specific software and tools for disciplines such as engineering (AutoCAD, MATLAB), or graphic design (Photoshop, Illustrator) is essential to be able to carry out complex technical tasks.

5.2. Soft skills.

In addition to technical skills, soft skills are crucial for successful performance in the STEM field. These skills refer to the interpersonal and management skills that facilitate collaboration, effective communication and teamwork. Some key soft skills include:

- Teamwork: Most STEM projects involve collaboration between professionals from different disciplines. Knowing how to work as a team, share ideas and coordinate efforts is essential for innovation and progress.
- Effective communication: The ability to communicate complex ideas in a clear and understandable way is essential. This includes both written and verbal communication, to convey research results, technical reports or presentations.

- Critical thinking: The ability to analyse information, identify problems and propose logical solutions is fundamental to solving complex problems in science and engineering.
- Time management and leadership: STEM professionals must be able to manage their projects, resources and deadlines efficiently, as well as have the ability to lead teams and make important decisions under pressure.

5.3. Adaptability and continuous learning.

The STEM environment is marked by rapid technological evolution and constant changes in methodologies and tools. For this reason, adaptability and continuous learning are essential to keep up with innovations and changes in the sector. The ability to learn new skills, adapt to new environments and face unfamiliar challenges is critical to long-term success.

- Ability to learn new technologies: STEM professionals must be willing to update their knowledge and skills as new technologies or methodologies emerge.
- Flexibility to change: Adaptability refers not only to learning new tools, but also to the ability to adjust to changes in working environments, market demands or research methods.
- Continuing professional development: Participating in courses, workshops, seminars and conferences is key to staying up-to-date in a dynamic field like STEM. In addition, access to new development opportunities helps professionals to improve their skills and stay competitive.

The key competences for success in STEM are not limited to technical skills, but also include a set of soft skills, along with the ability to adapt and learn continuously. The combination of these competences is essential to address current and future challenges in the field, and to contribute significantly to innovation and technological progress. The constant evolution in STEM requires professionals not only to be experts in their technical area, but also to be able to collaborate, communicate and adapt to a constantly changing environment.

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