METHODOLOGICAL GUIDE

THE VIRTUAL INTERNSHIPS IN TECH CENTERS

This guide is a result of the project:

VIRTUAL INTERNSHIPS IN TECH CENTERS: TRAINING VET STUDENTS WITH OBSTACLES INTO A INNOVATIVE DIGITAL METHODS OF REMOTE WORKING AND ELEARNING CREATED FROM COVID-19

METHODOLOGICAL GUIDE: VIRTUAL INTERNSHIPS IN TECH CENTERS

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CONTENTS

critical
Virtual Internships
in Tech Centers
thinking

INTRODUCTION

METHODOLOGICAL GUIDE: THE VIRTUAL INTERNSHIPS IN TECH CENTERS

This guide is the result of the project "VIRTUAL INTERNSHIPS IN TECH CENTERS: training VET students with obstacles in innovative digital methods of remote working and e-Learning created from COVID-19". The project has been funded thanks to the **ERASMUS+ PROGRAMME** through the **SPANISH NATIONAL AGENCY – SEPIE.** This project has been developed with the aim of contributing significantly to the employability and inclusion of VET students, especially those with obstacles, through an innovative methodology and efficient learning tools that make use of scientific and critical thinking. Its focus is on the design of virtual internships in technology companies. We want to encourage these students to have the opportunity to carry out virtual work internships. It is necessary to develop methodologies specially adapted to this sector so that these internships are really effective, achieve the inclusion of students, and help them to configure a competitive curriculum that facilitates their access to the labor market.

Implementing effective virtual work internships, especially if they are in the field of the technology sector (which requires high levels of confidentiality, the use of innovative devices, and work in multidisciplinary teams), is not easy. It requires adaptations in working methods, the use of specific tools, establishing continuous monitoring measures, and appropriate methods that promote the capability for initiative and responsibility of the users of the mobilities (VET students with obstacles), the company's own tutors, and the intermediate cycle (VET) centers.

Therefore, this project has developed this Intellectual Output, the **"METHODOLOGICAL GUIDE: THE VIRTUAL INTERNSHIPS IN TECH CENTERS"**. The objective of this guide is to provide all the information, protocols, documentation, and control tools required by technology companies and VET centers to implement innovative and effective virtual internships (both for the student and for the company itself). It is sought that carrying out these internships does not require large investments in devices or staff dedication costs that neither small companies nor VET centers can assume, so, for example, we will make use of the opportunities provided by free software not only in telematic work tools but also in computer-aided design tools, editing, treatment and presentation of results, graphic design, image processing, and others.

In this guide we will propose a series of suggestions on the working methods that we consider appropriate to an internship in a company carried out by telematic means. These are issues that we think many companies can adapt to the design of their own internships. However, in order to better understand the methodological aspects of our proposal, we present the design of virtual internships according to 5 specific jobs. We want to offer both the Erasmus+ Programme and VET centers a tool adapted to the post-COVID-19 reality, to favor the employability and inclusion of VET students.

To close this introductory section, we want to thank the support of the Erasmus+ Programme, which has made it possible to gather seven prestigious entities from technology companies, VET centers, and experts in the development of innovative learning methodologies from five countries of the European Union (Spain, France, Portugal, Italy, and Greece) to work on training materials that provide VET centers, technology companies, and its workers and students with useful tools to carry out virtual internships in the technology sector.

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**Virtual Internships
in Tech Centers**
thinking

OBJECTIVES OF THE GUIDE

METHODOLOGICAL GUIDE: THE VIRTUAL INTERNSHIPS IN TECH CENTERS

This methodological guide includes the work developed by an interdisciplinary and international network of technology companies, VET educational centers, and experts in the development of innovative learning methodologies within the framework of the Erasmus+ Programme. For this reason, we have used fundamental perspectives for the training of VET teachers of intermediate degree cycles, and technicians of technological companies from different countries of the European Union.

The objective of this guide is to provide an innovative methodology adapted to the requirements of teleworking and the economic, social, and cultural obstacles of VET students, so both technology companies and VET centers can implement innovative and effective virtual work internships for these students.

Thus, this guide offers teachers and technicians of companies the protocols, information, documentation, control tools, and adaptation methods necessary to host virtual work internships, allowing VET students with obstacles to have the opportunity to carry out internships that promote their inclusion, learning, and employability without large costs or investments in device.

WITH THIS GUIDE, WE SEEK TO OFFER METHODS THAT HELP TO PROGRAM THE TRAINING PROCESS TO TECHNOLOGY COMPANIES, VET CENTERS, AND VET STUDENTS.

The objective is to offer a powerful tool, adapted to the post-COVID-19 reality, to favor the employability and inclusion of VET students. It is devised to be used by many labor sectors, although, to be specific in terms of the presentation of our methodology, we show the definition of internships according to 5 specific jobs. We believe that these virtual internships can be an effective mechanism to overcome the severe problems that the coronavirus created, especially for teachers and students, providing them with opportunities to carry out internships in companies that form essential skills to secure their future work.

WE OFFER VET CENTRES...

– Suggestion of free download software.

– Suggestions for the communication, monitoring, and scheduling charts.

– The control of the laboratory notebook.

– Suggestions of the devices required in the VET center.

WE OFFER TECHNOLOGY COMPANIES...

– Models of internships adapted to teleworking.

– Suggestions on the training of VET students in the functions they will have in the company.

– The definition of the jobs to fill.

– Suggestions of the devices required in the company.

– Suggestion of free download software.

WE OFFER VET STUDENTS...

– Daily work processes (scheduling, communication, creation of reports...).

– The use of the laboratory notebook as a follow-up mechanism.

– Suggestions of the devices required.

– Suggestions of free download software.

2.1. OBJECTIVES OF THE VIRTUAL MOBILITY FOR VET STUDENTS WITH OBSTACLES.

Virtual mobility opens the path to internships in technology companies in any country, to which until now many students with obstacles did not have the opportunity to access, it being for the student an educational, intercultural, and technological experience, getting a recognition of studies and a contribution in their curriculum that will favor their access to the labor market.

Therefore, virtual mobilities for VET students with obstacles gives them the opportunity not only to participate in projects and activities that lead to the acquisition of knowledge, skills, and aptitudes, but also provide them with the transversal competences essential for their personal, professional, and social development, thus favoring their inclusion and employability.

These competences are in line with those provided for in VET diplomas, such as:

- The ability to adapt to the different jobs that may be offered, and to the new work situations they can face, motivated by technological and organizational changes in production processes.

- Capabilities for machine learning.

- The ability to adapt to working methods in interdisciplinary teams.

- Participate actively in the work of the group with responsibility and critical attitude.

- Solve problems and make individual decisions following the rules and procedures established in the company.

- Develop their analytical skills and digital skills, allowing them to enhance their labor, social, and personal inclusion.

- Comply with the objectives set and established quality system protocols.

PARTICIPATING IN A VIRTUAL INTERNSHIP WILL ALLOW STUDENTS TO:

- Encourage collaborative work and the development of critical thinking and specific skills of the technology sector.

- Have the opportunity to apply the knowledge acquired during their studies through participation in innovative projects.

- Promote their employability thanks to the improvement of their curriculum and their participation in cutting-edge innovation projects.

- Develop their analytical skills and digital skills, allowing them to enhance their labor, social, and personal inclusion; have the opportunity to exchange experiences and knowledge with other students and business technicians.

2.2. OBJECTIVES OF THE VIRTUAL MOBILITY FOR VET CENTERS.

Virtual mobility is an opportunity for VET centers to generalize internships to the vast majority of their students.

The main objective of virtual mobilities for these centers is to give them the opportunity to offer their students access to accredited work experience in technology companies, improving the training and learning processes of their students, especially those with obstacles, as well as facilitating their inclusion and access to the labor market.

2.3. OBJECTIVES OF THE VIRTUAL MOBILITY FOR TECHNOLOGY CENTERS.

Virtual mobility represents an opportunity for technology centers to improve their work processes, guiding and adapting them to teleworking, which is being promoted based on the experience acquired during the COVID-19 pandemic.

However, the main objectives of virtual mobilities for these companies are to enhance the teaching capability of researchers and technicians, bringing them closer to the reality of VET education and students with obstacles, as well as knowing the potential of these students thanks to their participation in research projects.

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in Tech Centers**
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DEFINITIONS & CONCEPTS

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INTERNSHIPS IN TECH CENTERS**

ON-SITE MOBILITY. It is the trip of a student to carry out the internship of his/her training cycle in an institution of a different country. This mobility provides students with transversal skills for their personal, professional, and social development.

VIRTUAL MOBILITY. This is a type of student mobility in which students carry out the internships remotely.

VET INTERNSHIPS. It is a period of internships in a real environment of a company, in which students carry out tasks typical of the professional profile of the VET degree they are studying or have just finished. Each student has a tutor from the center and a tutor from the company, responsible for defining the training program, coordinating the monitoring and development of the internship, and carrying out its evaluation.

VOCATIONAL EDUCATION AND TRAINING (VET). Vocational education and training are a set of teachings, in a wide range of fields, aimed at training and acquisition of practical competences and skills that allow the professional development of students.

ECVET. The European Credit Transfer System for VET (ECVET) is a tool created by the European Union in 2009 to support learning, student mobilities, and the flexibility of training pathways. This system allows students to validate their qualifications and acquired knowledge so they are recognized either in their same country or abroad. In this way, students have the opportunity to integrate learning outcomes more easily into their training.

MEMORANDUM OF UNDERSTANDING (MoU). The MoU is an agreement that establishes the operating conditions of the partnership between the company and the educational institution regarding the objectives, duration, and modalities of revision of the agreement itself. Through this document, the partners establish their respective criteria and procedures of quality, safety, evaluation, validation, and recognition of skills and competences for the transfer of ECVET credits.

LEARNING AGREEMENT (LA). It is a document of agreement between the sending organization, the host organization, and the student, which states that the host organization

will evaluate the learning outcomes acquired by the student and the sending organization will validate and recognize them according to the established rules and procedures.

CRITICALTHINKING4VET. It is a European network formed by prestigious technology centers that develop cutting-edge projects in a wide variety of fields (biosanitary, smart materials, nano components …) and VET centers. Both sectors collaborate to create technical and labor training adapted not only to the needs of the technology sector, but also to those of students with obstacles. From the network, we believe that VET technicians have a key role in the development of high-tech projects, especially those young people with more obstacles who despite them show capabilities for improvement, dedication, and learning that makes them overcome all their barriers. On the other hand, technology centers can play a key role for these youth, providing them with a new experience that helps them access the labor market and develop fundamental skills for their social, professional, and personal future.

CRITICALTHINKING4VET METHODOLOGY. This methodology uses critical thinking as the basis for decision-making and evaluation of the consequences of one's actions. In teleworking, the importance of initiative and autonomous management of work increases when compared to on-site work. It also structures a daily monitoring of the work through the creation of the **digital laboratory notebook**, a document created daily via smartphone by the student, in which they don't just state what they do in their day, but also raises previous hypotheses to each of their actions and states to what extent their forecasts were fulfilled afterwards.

SCRUM METHODOLOGY. This methodology allows you to efficiently manage the workflow thanks to the fact that the team knows what are the objectives, tasks, and times in which it must be done. It is a method designed for the creation of software, but that will provide essential concepts for teleworking, such as the transformation of project requirements into short and fixed temporary blocks, the daily synchronization of work, and the development of adaptations, the establishment of times, and the definition of authority and delegation of responsibilities.
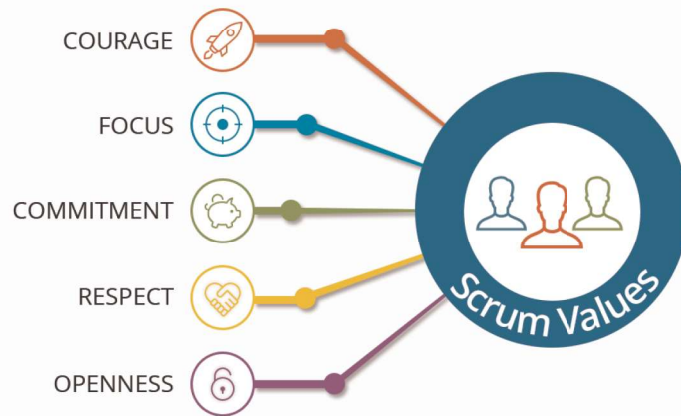
COURAGE

FOCUS

COMMITMENT

RESPECT

OPENNESS

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Virtual Internships
in Tech Centers
thinking

FRAMEWORK OF VIRTUAL MOBILITY

METHODOLOGICAL GUIDE: THE VIRTUAL INTERNSHIPS IN TECH CENTERS

4.1. OVERVIEW OF THE REGULATORY FRAMEWORK FOR EUROPE.

The European Commission has adopted a new Digital Education Action Plan with the aim of enhancing the contribution of education to the European Union's recovery from the COVID-19 pandemic and contributing to building a green and digital Europe.

In the communication made by the European Commission on 30 September 2022[1], they stressed the importance of cooperation to enrich the quality, inclusion, and the digital and ecological dimension of the education systems of EU member states.

It also specifies both the mechanisms and goals to overcome to achieve the European Education Area until 2025, with the support of the European Recovery Plan (NextGenerationEU) and the Erasmus+ Programme.

This communication highlights the set of initiatives proposed by the Digital Education Action Plan (2021-2027) aimed at high-

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[1] *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Digital Education Action Plan 2021-2027, Brussels, 30.9.2020 COM(2020) 624 final.*

GUIDING PRINCIPLES TO ADAPT EDUCATION AND TRAINING SYSTEMS TO THE DIGITAL AGE

1. Inclusive and high-quality digital education.

2. The transformation of education for the digital age corresponds to the whole society.

3. Investing in connectivity, devices, and organizational skills that ensure access to digital education for all.

4. Digital training and education play a key role in enhancing equality and inclusion.

5. Digital competences should be a core capability of all teachers and training staff.

6. Education leaders play a key role in digital education.

7. Digital literacy is key to life in a digitalized world.

8. Basic digital skills should be part of transferable core skills.

9. High-quality educational content that boosts the relevance, quality, and inclusiveness of European education and training at all levels.

10. The need for all people to have the most advanced digital skills.

quality digital education in Europe characterized by inclusion and accessibility. The main objective is to achieve education and training systems that are truly fit for the digital age, as the crisis suffered by the coronavirus has placed distance learning at the heart of educational practices.

The priorities of this plan are:

1. Fostering the development of a high-performance digital education ecosystem.

2. Improve digital skills for digital transformation.

In this sense, the mobilities, both physical and virtual, are greatly important to students, since they offer them a large number of opportunities to expand their professional, social, and intercultural skills[2].

87%
Of young people are satisfied or very satisfied with their Erasmus + Virtual Exchange experience

84%
Are interested in future Erasmus + virtual exchange opportunities

76%
Agreed that virtual exchange had helped them improve team-work

76%
Of participants agreed that the virtual exchange had helped them improve their digital competences
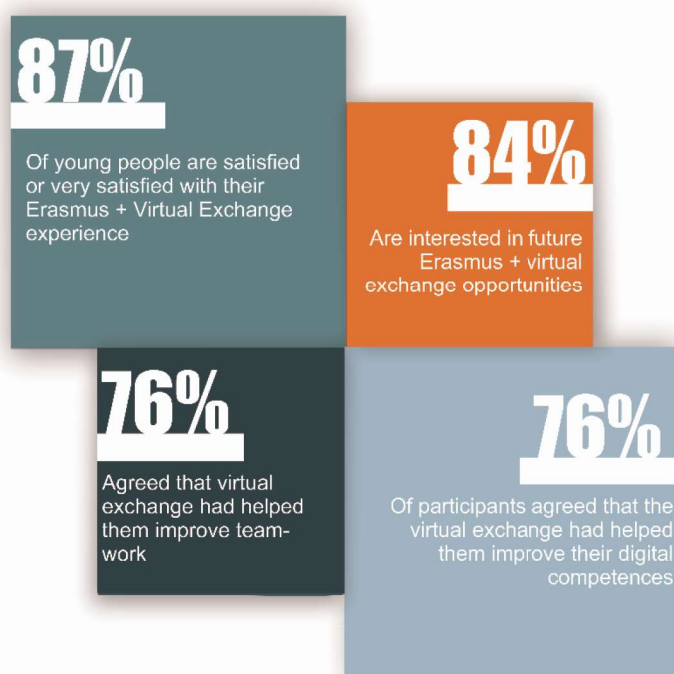
The Erasmus+ Programme, considered one of the flagship and most successful programmes of the European Union, offers help to all those who want to study or train abroad, as well as those projects that promote cross-border cooperation, as stated by the European Commission.

As a complement to the traditional physical mobility programme, it has incorporated an online version into its mobility actions, with the aim of connecting more students and young people from European countries and neighboring countries located to the south of the European Union. To this end, the European Commission has launched a project aimed at

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[2] https://youth.europa.eu/erasmusvirtual/impact-erasmus-virtual-exchange_en

promoting the improvement of the skills of thousands of young people through digital learning. This initiative, known as "Erasmus+ Virtual Exchanges", encompasses 33 E+ countries, Algeria, Egypt, Israel, Jordan, Lebanon, Libya, Morocco, Palestine, Syria, and Tunisia.

These mobilities will connect young people, youth workers, students, and academics through debates, transnational project groups, online courses and training in the field of defending collective interests, all part of higher education programs or projects organized for youth. These exchanges represent a great opportunity for these young people not only to acquire knowledge and skills, but also to reinforce tolerance and mutual acceptance.

Tibor Navracsics, Commissioner for Education, Culture, Youth and Sport, said: *"Although Erasmus+ is a very successful programme, it is not always accessible to everyone. Through Erasmus+ Virtual Exchanges we will facilitate the establishment of more contacts between people, reach young people from different social backgrounds, and promote intercultural understanding. This online tool will connect more young people in the EU with young people in other countries; it will build bridges and develop skills such as critical thinking, media literacy, foreign languages and teamwork"*[3].

Carme Anguera, director of international projects in the Globalization and Cooperation Area of Universitat Oberta de Catalunya (UOC), said: *"When mobilities are carried out in the digital environment, in addition to a very enriching international experience, they are also a possibility to democratize international experiences, allowing those students who cannot move abroad for a semester to live an international educational experience. Virtual mobilities and on-site mobilities must be complementary and can coexist, thus giving a response to the whole student"*[4].

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[3] Erasmus+ goes virtual

[4] https://www.uoc.edu/portal/es/news/actualitat/2021/141-movilidades-virtuales-internacionales.html

4.2. SPECIFIC REGULATORY FRAMEWORKS: GREECE, PORTUGAL, FRANCE, AND SPAIN

The information used for this section has been extracted from [Eurydice](#), a network established by the European Commission and the Member States of 40 national units based in 37 countries of the Erasmus+ Programme, with the aim of providing information on how education systems are organized and work in Europe. It provides a broad source of information, including both detailed and general descriptions of national education systems, comparative reports, indicators and statistics, and news and articles related to the field of education.

SPAIN

The current educational legislation shows the commitment of the Spanish education system with the European and international dimension of education, assuming the challenge of opening it to the outside. Educational action abroad facilitates both access to non-university studies offered in the Spanish education system, as well as the promotion and dissemination of education, culture, and language.

Regarding student mobilities, which favors promotion, internationalization, quality, and excellence in education, it gives students the opportunity to study or work abroad.

The student mobility programs are framed within the educational actions of the **Erasmus+ Programme** of the European Commission. Specifically, in Spain, the management of public calls depends on the Spanish Service for the Internationalization of Education (SEPIE).

Among the actions of the Erasmus+ Programme are the Strategic Partnerships, which allow the participation of students and staff between centers and educational

institutions of Early Childhood Education, Primary Education, Secondary Education, Higher Education, and Adult Education.

As for the mobilities of VET students, which we are dealing with in this guide, they are intended both for students of VET Cycles, and those who have recently graduated and want to carry out a mobility in a participating country of the Erasmus+ Programme other than their home country.

These mobilities can be of short (2 weeks to 3 months) or long duration (3 to 12 months). Upon completion, students receive an official certificate for their learning outcomes. Likewise, these students will receive an individual financial support to cover the expenses of travel, housing, maintenance, and language support before and during the mobility. Additionally, they will also receive financial support to cover both the costs derived from the special needs of the participants and the additional costs of those participants with fewer opportunities.

> The aim of these transnational mobilities for internships in another EU country is to strengthen employability and facilitate their transition to the labor market.

Organizations sending and hosting mobilities can be VET centers or any public or private body in the labor market or in the field of education, training, and youth. The organizations will receive financial support to cover the management costs of the students carrying out the mobilities, regarding linguistic, pedagogical, or intercultural preparation, validation of learning outcomes, follow-up, or support.

PORTUGAL

In Portugal, mobility and internationalization in education and training focus on three priority areas of cooperation (EU-level, International Area, and Development Area).

This involves the following national bodies:

- General Secretariat of Education and Science, which coordinates the international work of the Ministry of Science, Technology, and Higher Education and the Ministry of Education, ensuring the coherence of their respective bodies and services, as well as coordination with the Ministry of Foreign Affairs.

- Directorate-General for Higher Education (regarding higher education).

- Directorate-General for Education (regarding school education).

- National Agency for Qualification and Vocational Education, I.P. (on vocational education and training).

- ERASMUS+ National Agency for Education and Training, which helps implement the European Union Programme, under the supervision of the Ministry of Education, the Ministry of Science, Technology and Higher Education and the Ministry of Labor, Solidarity and Social Security.

Regarding the European Union, cooperation in education and training takes place at both national and European level through a variety of programmes, activities and projects.

In recent years, the internationalization of education has been a priority, as demonstrated by international initiatives in accordance with the strategic plan for the development of the

Portuguese education system. In this sense, Portugal has implemented measures to ensure the mobility processes of students and graduates.

In the education and training sector, the national organization, management, and coordination of the Erasmus+ Programme is the responsibility of the Erasmus+ National Agency for Education and Training.

The internationalization of the VET sector is supported through participation in the Erasmus+ Programme, both in Key Action 1 and in Key Action 2, whose main objectives are to:

- Facilitate the personal development and employability of VET students.

- Make VET more attractive through the mobility of students and staff.

- Increase the suitability of skills and reduce labor shortages in economic sectors by adapting curricula and qualification profiles and establishing stable partnerships between VET providers and economic operators, including social partners, development agencies, innovation system organizations and Chambers of Commerce and industry associations.

- Support the promotion of permanent, easily accessible, and career-oriented VET, even for those least likely to participate in these learning activities.

- Increase the relevance of VET to labor market demands.

- Increase transparency and mutual trust between VET systems by streamlining and implementing the recommendations of the European Credit System for Vocational Education (ECVET) and the European Quality Assurance in Vocational Education and Training (EQAVET) at the national level.

Projects can be coordinated by any public or private organization active in VET, sending students and staff members to Europe, or the coordinator of a national mobility consortium. Also included are organizations linked to the labor market; organizations carrying out cross-cutting activities in different areas (e.g. companies, chambers of commerce, NGOs); any organization established in a Programme Country. Organizations from partner countries can participate as partners, provided that this participation adds value to the project.

BENEFICIARY RESPONSIBILITIES INCLUDE

- Funding management.

- Local and transnational project activities.

- Reception of partners.

- The organization and procedural aspects associated with the safety and well-being of participants.

- Monitoring information, dissemination and reporting to the National Agency.

- Validation and recognition.

Mobility and participation in partnership activities are recognized with a certificate of partner participation. However, it can be established that mobility corresponds to the curricular mobility of the student. It is worth mentioning that the history of mobility through the Europass Mobility document has become increasingly important within the Erasmus+ Programme.

FRANCE

The direct contribution to education and a set of initiatives contribute to the development of the European and international dimension of education in France. In line with the major European objectives, France seeks to promote the international mobility of young people and adults. Public authorities have set themselves ambitious targets for international student mobilities.

The circular of 15 June 2016 reaffirms the importance of student mobility, their recognition in their career and redefines the framework and conditions. Therefore, educational achievements built within the framework of mobility abroad will be fully recognized. For each student, a certificate will be produced to highlight the skills acquired by the student on this occasion.

Students have access to numerous resources and information platforms. For example, the National Information Office on Education and Professions (ONISEP) has created the "*Ma voie pro Europe*" platform, which provides information and advice to secondary school students in vocational education and higher education students wishing to stay in Europe as part of volunteering, internships, training or an exchange programme.

Finally, like the rest of the countries of the European Union, public education policies in France are part, among other things, of the strategic framework "Education and Training 2020", for which two objectives have been set in terms of learning mobility.

Since 1980 there has been an agreement between France and Germany on the organization of exchanges between young people and adults in initial and continuing vocational training. Its objectives are:

- Allow participants to continue part of their training in the other country.

- To enable them to benefit from country-specific training methods for a stay of sufficient duration.

- Introduce participants to the professional and socio-cultural life of the partner country.

- Create links between French and German apprentices and between partner organizations.

- Bring together youth and adults from both countries;

- Promote the mobility of young people and adults.

GREECE

Greece promotes, plans and implements initiatives, strategies, and actions related to the European and international dimension in education and training. To this end, measures are adopted and actions are implemented that aim at the objectives of the strategic plan "Education and Training 2020".

By promoting European and international educational cooperation, these policies aim to strengthen the quality of education, effectively meet the needs of modern Greek society and embrace the world's cultural diversity and heritage.

The European and international dimension of education is promoted through:

- Greece's participation in the development and implementation of EU education programs and policies.

- The participation in European and international organizations and their programs.

- The development of national initiatives for the conclusion of bilateral and multilateral educational agreements.

- The promotion of the European and international dimension in curricula at all levels of education and training.

- The promotion of Greek language education and improvement of Greek studies abroad.

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**Virtual Internships
in Tech Centers**
thinking

METHODOLOGICAL BASES OF THE CRITICALTHINKING4VET VIRTUAL INTERNSHIPS

METHODOLOGICAL GUIDE: THE VIRTUAL INTERNSHIPS IN TECH CENTERS

We propose an active methodology in which students must progress in the skills that we think they should develop while carrying out a technological group project of 3 to 6 students. Since these are virtual internships, one should take advantage of teleworking, so the groups are made up of students from different European countries.

The group will be led by a tutor from the company and guided by teachers from educational centers and business professionals to whom students can turn to solve specific questions. It is necessary to be realistic about the time that a company tutor can devote to the attention to these internships; it is important to work thoroughly on the techniques of autonomous work of the group and in the communication of the students with their tutor so the project advances effectively.

Some dangers for a training program like this one are both the neglect of the students that produces a lot of downtime in the progress of their project, and the saturation of the tutors, which makes it impossible for the company to continue in the project. The techniques that must be applied in this sense are not obvious; in this project we have developed a guide for teachers of educational centers or for company tutors and courses both for students in which we try to specify certain recommendations that we think can contribute to the training process being effective.

Another essential aspect of the success of the process is defining the project that the students are going to carry out in the company. The same as in an on-site internship, the work that students do in the company must be of interest to the company, not something marginal. It is natural that the definition of the project must start from the company. However, for the virtual internship to be truly formatively useful for students, a thorough reflection on the pedagogical aspects is necessary. Company objectives should be complemented with student skills training objectives such as critical thinking, group work skills and others that we have mentioned before. Rather, the training of students in these skills must result in greater achievements regarding the objectives set by the company. In this sense, it is very important that the definition of the project for the virtual internship involves interdisciplinary groups in which the company collaborates with teachers of training centers.

This is what has been done in this project when defining a series of virtual internships by the companies that participate in the partnership.

A third aspect that we want to emphasize is the value of a curricular internship in the transition of the student from the training center to the work environment. The curricular internship is usually the first work experience of the professional. The danger is intuited that this aspect of business internship can be distorted if the internship is done virtually. It is important that the definition of the projects and the forms of work that are proposed to the students from the first day have a categorical impact on the fact that from the beginning of the internship they are considered as workers of the company subject to the obligations and rights of any other on-site worker.

5.1. VIRTUAL WORK IN HYBRID TEAMS.

Hybrid teams are those that combine on-site work and remote work (teleworking). The CRITICALTHINKING4VET virtual internships will be characterized by hybrid teams in which the technicians of the companies will work on-site and the VET students will carry out the internships remotely. To carry out virtual work in hybrid teams it is important to consider the following aspects:

- **Set objectives**. One of the competences that internships must influence is the ability to set objectives and analyze them critically. It is natural that the company will set the general and specific objectives of the project on which the internship to be carried out by the group of VET students will focus. However, to advance in the development of this competence in students it is relevant to leave a space for the definition of objectives, probably short-term, by the students themselves and establish the methods for their discussion and the evaluation of the degree to which each of them is achieved.

- **Communication**. It is an essential element to work in hybrid teams. In order to reconcile on-site and virtual work, it is necessary to have communication tools that facilitate collaborative work, as well as personal interaction between team members. Communication tools to be used will be free videoconferencing platforms.

- **Distribution of work.** Among the objectives of the virtual internships, we have raised before the development in students of competences related to responsibility and the fulfillment of objectives. One of those competences in which students are intended to advance is in the effective use of working time.

This aspect is not trivial in virtual internships, especially when it is the first work experience of a VET student, it is more difficult than in an on-site internship, in

which the student is immersed from the first day in a work environment with well-established methods. In the virtual internship, students will have a much more limited contact with the environment of his company. It is necessary to reflect on this problem with students and establish the methodology for students to schedule daily tasks.

It is very helpful to propose a breakdown of tasks and their scheduling in the definition of the project as a frame of reference for students to analyze the progress of the work and will help them get the most out of virtual internships.

- **Collaborative work.** It is important to establish the rules of collaborative work both among VET students who carry out the internship in the definition of each project and with their tutor and other workers in the company. Students will be trained in

documentation storage and sharing tools such as Dropbox or Google Drive.

- **Virtual meetings.** In order to implement virtual work in hybrid teams, it is necessary to hold periodic virtual meetings (daily and weekly) between company tutors and VET students.

These meetings are an opportunity to bring the whole team together and exchange ideas and expose the results and the work done by the students so far so the other students and tutors can give ideas, correct mistakes, exchange positions, develop critical thinking, and know the progress of the work. Likewise, these meetings allow to mark common objectives.

This work format allows VET students with obstacles to have the opportunity to carry out work internships in technology companies despite severe situations like the COVID-19 pandemic, which for months prevented them from having a first approach to the labor market.

5.2. BASES OF VIRTUAL COLLABORATIVE AND COOPERATIVE WORK.

Collaborative work is based on a work environment in which students who carry out the internships form a work group.

Through the exchange and discussion of ideas, students contrast the results, reach important conclusions, solve problems as a team, and generate a spirit of learning, solidarity and collaboration. Likewise, it is an effective means to encourage the development of critical thinking and value the knowledge and work of others.

BASES OF VIRTUAL COLLABORATIVE AND COOPERATIVE WORK

1. Communication.

2. Participation.

3. Co-responsibility.

4. Collaboration.

5. Evaluation and continuous monitoring of work.

COMMUNICATION. Effective communication is one of the main tools for collaborative work, especially in virtual environments. The contact between students and the tutors of the company must be constant and frequent, favoring the operation and collaborative work. For this, it is necessary to establish, from day one, the mechanisms that will be used to communicate and exchange ideas. For this, is essential to make use of email, tools to share documents such as Dropbox or Google Drive, tools to carry out virtual meetings such as Google Meets or Skype, chats, the use of the phone…

PARTICIPATION. Interacting with the rest of their peers is essential to work collaboratively. Through group work, team members not only develop critical thinking, but also share knowledge and experiences, acquiring skills for the argumentation of ideas. Participation allows the exchange of ideas, which involves both the presentation of ideas and the defense and evaluation of one's own conclusions. The internship will develop effective communication skills both oral and written. The suggestions, opinions and affirmations must

be made through reasoning and argumentation that allows the rest students and workers to understand you.

CO-RESPONSIBILITY. All team members must take responsibility for their tasks and those of the rest, generating mutual learning. Sharing responsibility allows individual and collective commitment. Therefore, it is very important that team members do not hide the mistakes made or direct a debate towards their own intellectual benefit, as they can cause wrong decisions that can lead to many inconveniences for the common project.

COLLABORATION. The basic principle of collaborative work, thanks to which students learn to work together, generating a mutual cooperation environment. Collaboration fosters mutual learning and the development of skills and aptitudes essential for the labor market.

EVALUATION AND CONTINUOUS MONITORING OF THE WORK. Thanks to the careful planning of the work plan and the continuous team review of the results achieved, it will be possible to react and reconsider the planned tasks to face possible problems that may arise in order to achieve the planned objectives.

However, for these bases to happen and both technology companies and VET educational centers promote collaborative work between groups made up of company technicians and VET students in internships, it is necessary to use tools that promote communication and cooperation, such as:

- **DROPBOX**. It is a cloud file hosting service through which users have the possibility to store, synchronize and share files and folders, not only online but also between computers, tablets, and smartphones. It is a useful tool to work as a team and advance during the project in a coordinated and effective way.

- **GOOGLE DRIVE**. It is another file storage service that allows to create documents, as well as share, comment, edit, and work online the same document from any device. It is an effective tool to work between students who are doing virtual internships and their tutors in technology companies.

- **GOOGLE CALENDAR.** It is an online calendar management tool with which one can schedule meetings with reminders. Google calendar allows you to specify with students the dates for the activities and planned objectives of the project, ensuring an adequate monitoring and control of the schedule.

- **WHATSAPP.** It is an instant messaging service that allows to communicate easily; very useful for students and tutors to communicate quickly through groups.

- **SKYPE.** It is a free software that allows to communicate through individual and group calls and video calls, as well as instant messages and sharing files. This tool allows to hold daily and weekly virtual meetings to carry out the follow-up of the work.

- **APP ON YOUR SIDE**. A digital software for mobile devices developed within the framework of the Erasmus+ project "VET STUDENTS INTO TECHNOLOGY COMPANIES" of the strategic network "CRITICALTHINKING4VET". This digital environment will guide the VET student throughout the internship process. In this app, students have specific training tools, a laboratory notebook to be implemented daily throughout the internship, and collaborative work tools, like a chat, access to a forum, linguistic resources, etc. Tutors will, on the other hand, not only have the opportunity to communicate through the application with students and other tutors, but also to follow up on the work done by students, through the correction and analysis of the laboratory notebook, and carry out the final evaluation of the internship.

On Your Side

VIRTUAL ASSISTANT FOR EUROPEAN MOBILITIES IN TECHNOLOGICAL CENTER

critical VET students into technology companies **thinking**

A digital educational software that will accompany the VET student at risk of exclusion, throughout the mobility process. This result will allow the student to feel safe during their mobilitym find resources that will help them when have problems and feel that their teacher and tutor are with them.

More information: www.criticalthinking4vet.eu/ep2019

Co-funded by the Erasmus+ Programme of the European Union

- **FORUM**. A forum is where students and teachers can brainstorm topics of interest, post topics, create discussions, and answer to messages from other participants. From the project's own website (www.criticalthinking4vet.eu/Ep2020) students and tutors will have the possibility to communicate through a free and freely accessible forum.

ROLE OF STUDENTS IN COLLABORATIVE WORK

- Strive to fully understand the objectives set in the internship.

- Strictly comply with the agreed working hours, participating in virtual follow-up and coordination meetings.

- Actively participate in debates and exchanges of ideas.

- Collaborate with the rest of the team, striving to fulfill the assigned tasks.

- Conduct a critical analysis of their trials and results.

- Effectively expose the results of their trials to the rest of the group.

- Reflect on problems that may arise.

- Contribute to the creation of an environment of trust and reflection.

ROLE OF THE TUTOR IN COLLABORATIVE WORK

- Plan the work that students must do.

- Guide the formation of the teams.

- Define the objectives of the project to be carried out by the students.

- Expose the tasks that students must carry out.

- Conduct virtual coordination meetings.

- Conduct weekly follow-up virtual meetings at a minimum.

- Participate in debates and exchanges of ideas.

- Carry out the monitoring and evaluation of students.

- Monitor the project and its objectives.

- Generate an environment of trust and reflection.

In short, virtual internships will exploit the network cooperation between VET students with obstacles and technicians from technology companies to maximize the advantages for both. They not only promote work in multidisciplinary teams, but also collective involvement, encouraging reflection and communication and allowing to evaluate one's own way of working, reaching conclusions, and solving problems. On the other hand, the work methodology that we are going to present will affect the development of self-learning skills. Thus, collaborative work allows you to acquire knowledge, skills, aptitudes, and attitudes fundamental to the world of work and personal.

In addition, thanks to the collaborative work between workers of technology companies and European VET students doing virtual internships, it will provide these students with a means to overcome problems that they may find in the labor market.

5.3. WORK METHODOLOGIES:

With the aim that students carry out virtual internships that are truly useful for their training and future work, and also for the technology companies that will host these internships, two methodological bases are proposed:

- **The CRITICALTHINKING4VET methodology**, which uses critical thinking as a basis for decision-making and evaluation of the consequences of one's actions. It is essential in teleworking, as the capability for initiative and autonomous management of work increases. It also structures a daily monitoring of the work through the creation of the digital laboratory notebook, a document that students create daily via smartphone, in which they not only show what they have done in the working day, but also raises hypotheses prior to each of their actions and indicates to what extent the results met the forecasts.

- **The SCRUM methodology**, a methodology that allows to efficiently manage the workflow thanks to the fact that the team knows the objectives, tasks, and times in which it must be done. It is a method that will provide fundamental concepts for teleworking, such as the transformation of project requirements into short and fixed time blocks, the daily synchronization of work, the generation of adaptations, the establishment of milestones, and the deadlines in which they must be achieved. The methodology also affects the definition of authority and delegation of responsibilities.

5.3.1. CRITICALTHINKING4VET METHODOLOGY.

The CRITICALTHINKING4VET methodology considers the development of critical thinking skills in students a priority. We believe that the most effective way of training students is helping them develop strategies to analyze for themselves how their reasoning works, how they come to accept or not the information they receive, how they reach conclusions, or how their position is shaped in situations they face in the work environment, or how they act to solve a problem. Work in a virtual environment especially needs these skills because in it, the autonomous management of work is essential.

Critical thinking is considered before all aspects of everyday life. It is about evaluating one's own way of reasoning (Paul and Elder)[5]. It is easy to perceive to what extent we accept without further ideas and approaches simply because it is the most accepted in society, in the group to which we belong, or by the authority that we recognize. Even simply for self-interest, for not contradicting previous decisions, or for not being singled out or marginalized. Applied to technological work, critical thinking skills translate into applying scientific and technical reasoning to each information received, judging whether or not it should be accepted as valid, judging each experimental design and the results obtained from it. It also leads to the question of whether the conclusions reached are really supported by the results and information available, are essential characteristics for technological innovation.
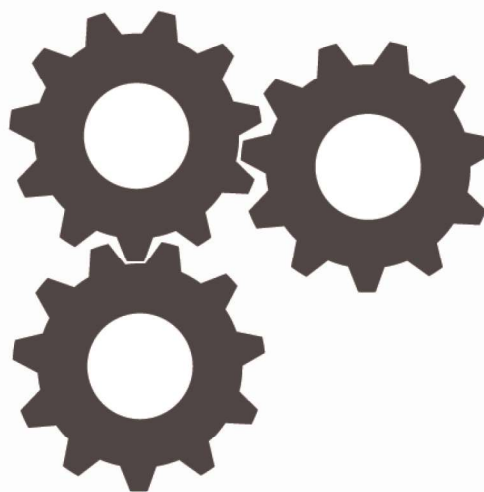
Helping students to be convinced of the richness of critical thinking and its contribution to their own personal development can act as a trigger for further development throughout life.

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[5] R. Paul, L.Elder 2005, *Critical Thinking Competency Standards. Standards, Principles, Performance Indicators, and Outcomes With a Critical Thinking Master Rubric*. Foundation for Critical Thinking 2005, Retrieved from http://www.criticalthinking.org/ accessed 3-3-2019

Critical thinking implies flexibility, willingness to recognize mistakes, to change one's mind, and accept the existence of other alternatives.

The main skills that characterize the CRITICALTHINKING4VET methodology are:

- **EVALUATING ONE'S OWN WAY OF REASONING.** One of the main skills of this methodology is the ability to analyze one's own way of reasoning. This, among other aspects that we will see in the following paragraphs, implies becoming aware that the social and work environment has an important influence on our ideas. Obviously, this is not easy for VET students. It involves an important effort of information search, study, and analysis.

A simple example is that of a technician who obtains numerical values from an experimental test in which he measures the mechanical resistance of plastic specimens. The machine gives results more or less automatically. The simplest thing is to transfer them as they are to a report, "if the machine has said it has to be true". It is difficult for the student to thoroughly understand the principle of operation of the machine in a reasonable time, but he is required to detect an absurd result and analyze what might be the origin of that failure.

> In the technological field, the student must be convinced not to accept any information, experimental result, calculation or conclusion if he does not understand it and reaches them as a result of his own reasoning.

In the example given, he may have made errors in the sizing of the sample, there may be defects at the edges that weaken the sample against breakage, the sample may have been compressed more or less when gagged in the machine, and many others. Training in critical thinking skills should lead to accept the possibility of making mistakes of misinterpreting information or that it is biased. The overexertion of analyzing for oneself the way in which results are obtained or conclusions are reached is extraordinarily compensated throughout the professional career and our methodology must be pending to continuously motivate students to reach this conviction.

- **RAISING PROBLEMS.** One of the strategies of critical thinking is to focus both learning and performing assigned tasks as problems that require a solution. This approach requires deepening the understanding of phenomena and the assimilation of concepts and experiences. You can think, for example, how different it is to ask a student to look for information and study about stepper motors or to look for the right engine for a specific application. The first can lead to accumulating pages of information and data tables that may not leave a trace after a short time, the second also requires that information, but also an analysis to find the solution to the problem posed and possibly will be remembered in a more lasting way. We return to that this requires an overexertion on the part of the student and consequently the motivation on the part of teachers and tutors convincing him of the profitability of that over effort.

> Testing a hypothesis gives the student the opportunity to reflect on any essay, assess their previous and subsequent knowledge.
> In short, acquire fundamental critical thinking skills.

- **ASKING RELEVANT QUESTIONS.** One of the keys to critical thinking is to teach students to ask the relevant questions about each topic. Questions help boost reflective thinking, expand thinking skills, understand and link different ideas, foster curiosity, and pose challenges. They will also help them acquire effective communication skills.

- **PROPOSING A HYPOTHESIS.** The approach of a hypothesis is one of the main elements of the scientific and critical method, because it allows the student to develop a previous idea with the knowledge available, to evaluate it and contrast it with the final result and the information that has been acquired in the process.

- **LOOKING FOR INFORMATION.** It not only allows to acquire new knowledge on any subject, but teaches the student to select the most relevant documents and assess the credibility of the information obtained, contrasting it with the different sources. The objective of this point is for students to distinguish relevant information and draw conclusions from the information received when it is supported by facts and logical

reasoning. Likewise, the capability to organize conceptually the information received is developed. Then, the fact of sharing that information with the components of a team in the company forces to develop effective communication skills.

- **AN OPEN MIND.** Both for collaborative work and for the development of critical thinking, it is important to be able to admit one's mistakes or errors, listen to, and accept the opinions of others, defend one's own ideas without fear rejection, and put oneself in the place of another in order to understand their point of view.

- **INTELLECTUAL INTEGRITY.** Honesty at work in a company is an aspect of enormous importance. It is important to have enough integrity and confidence not to hide mistakes made. Another essential aspect is learning to debate with the objective of the group in mind, directing debates towards one's own benefit to "win the argument", will go against reaching the most effective solutions.

- **EXPRESSING WELL.** Expressing oneself clearly and defending one's own ideas and conclusions force the student to specify their own thinking and discover points of inconsistency or what one has not understood well.

> Don't give up on complex problems and to be able to break down a complex task into simpler ones.

- **BE PERSEVERING.** Speaking of perseverance is also speaking of optimism, self-esteem, and confidence in the ability to overcome obstacles.

Students will have the opportunity to develop all these skills through the DIGITAL LABORATORY NOTEBOOK, one of the key aspects of this methodology. This is a document of work and daily follow-up that the student creates via the smartphone application "On your Side", cited in previous paragraphs, and that has a structure that deals with specific aspects for the student's training in critical thinking.

In this notebook students will begin each working day making entries that contain elements that can hardly be filled without prior reflection that makes them understand well the task they are going to perform.

The laboratory notebook is considered a great tool to compile experimental protocols, and to transmit experience within the company or research group.

IN THE LABORATORY NOTEBOOK, STUDENTS SHOULD WRITE SHORT TEXTS THAT SHOW:

- Understanding of objectives. The student must show that he has understood the objectives that the tutor has indicated in the daily virtual meetings.

- Explain the task to be performed.

- Explain what the working hypothesis is, the results you expect to obtain.

- Reason the methodology that will be used.

- Describe step by step the test and the results obtained.

- Evaluate if the result matches the hypothesis proposed.

- Assess the reproducibility of the assay.

- Evaluate the success or failure of the trial.

- Present the results to the team and write down the comments made by the rest of the members.

5.3.2. SCRUM METHODOLOGY.

SCRUM consists of a dynamic work methodology that allows to coordinate and structure the management of collaborative work with the aim of achieving the best possible result of a project. Although this methodology is mainly used for work teams focused on software development, it can be applied to other areas.

SCRUM is based on continuous and mutual learning, based on the fact that team members do not have all the knowledge from the beginning, but acquire skills and aptitudes as a project evolves.

FEATURES

- **Transparency.** All team members know the objectives and progress of the project.

- **Inspection.** The progress of tasks is frequently monitored, making it possible to detect and deal with potential problems that may arise.

- **Adaptation.** This methodology is characterized by adapting to the changes that may arise to achieve the objectives.

STAGES of the SCRUM methodology:

- **PLANNING** is carried out the first day of work in this process, through which the objectives of the project are selected and the list of tasks necessary to carry them out is created, estimating the time required by each of them together, and assigning them to the members of the team, with the aim of collaborating, sharing knowledge, and solve problems together that may arise.

- **EXECUTION**. Through daily coordination meetings, team members carry out the evaluation and monitoring of the progress of the work. These meetings allow everyone to show their work and doubts in order to exchange ideas, suggestions, and perspectives. To do this, team members must answer three questions:
  - What is the work done since the last meeting?
  - What work will I do to continue helping with the team's goals?
  - What problems have I found and/or do I think I will find?

This process develops collaborative work, allowing to solve and/or prevent together the problems that one cannot solve on their own. Also, thanks to these meetings the team has the opportunity to adapt the tasks and schedule if necessary to achieve the objectives.

- **REVIEW AND RETROSPECTIVE.** Through a final meeting, team members review the work done and analyze their way of working, the problems found, and the method by which they have solved them, as well as the way to improve both as a team and individually.

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SPECIFIC ACTIONS TO ENHANCE INCLUSION AND OVERCOME BARRIERS IN VIRTUAL WORK

METHODOLOGICAL GUIDE: THE VIRTUAL INTERNSHIPS IN TECH CENTERS

The global pandemic dramatically altered the way our world functions, and impacted all sectors of society and everyday life, including all levels of educational institutions, internships, and working settings. Massive distance education and work training have replaced the traditionally standardized ways, while remote teaching and the online managing of work teams have become the basic tool widely used to provide and support non-stop learning in most countries worldwide.

Due to the lockdown of campuses, schools, or work places, all kind of learning modes were automatically shifted to online, creating an urgent need for educators and trainers to control and overcome the challenges, barriers, and concerns that appeared during this new social situation.

Similar to leading a team in-person, a remote teacher, an internship instructor, or a work manager should set up effective technology, communication, and workflows for their remote learners or employees. Many traits found in on-site work places are also found in managing remote teams, although there are several crucial nuances to serving, leading, and guiding when managing teams you don't meet in person each day.

Even in remote learning, the educational center should:

- Create a safe space for the team to thrive in.

- Support each team member in achieving their own goals.

- Make the team shine as a whole.

- Accomplish great results regarding productivity.

This is an article that discusses the barriers that students face in remote internships and investigates the actions, processes, and resources that can support inclusion and an effective overcoming of the crisis in a virtual work environment.

First and foremost, a manager, educator, or leader of a team should consider that even in a remote work setting their job is to support and direct their team by coaching on specific tasks, projects, or career paths, listening to questions and possible misunderstandings, and guiding the processes towards results. Directing a team of students means working with the team cross-functionally to define goals and results, but also organizing what actions to take to get to a result, reinforcing values and applying them to remove roadblocks and reduce friction and stress.

6.1. WHAT ARE THE MAIN BARRIERS STUDENTS FACE DURING VIRTUAL INTERNSHIPS?

One of the largest barriers right now has been the so-called **digital gap**, made more prominent in a time when people face severe job insecurity, while students may not be allowed to physically attend educational institutions. More specifically, this term refers to:

- Digital inequality, such as lack of access to internet and devices at home.

- Availability or not of resources such as computers or tablets.

- Difficulty adjusting learning and teaching styles.

- Poor communication between educators and learners.

> *Students' participation in online learning activities is interrupted due to deficient internet connectivity in rural areas and the slow internet connection frustrates the learners while trying to access the learning platforms and materials (Muthuprasad et al., 2021). Students find it challenging to stay connected and learn online from home (Rahiem, 2020). Therefore, immediate intervention strategies should be considered to help strengthen the communication and collaboration between schools and parents to better facilitate children's learning.*

Increasing social and digital gap results in an isolation of the poorest members of society, with devastating effects regarding their learning or work training. Many students are left facing the choice between food and data. Without access to a computer at home, siblings are forced to share one phone to partake in lessons. These disparities, dependent on socioeconomic status and region, have only got worse since COVID changed everything.

The lost education and opportunities for the most vulnerable groups has made digital exclusion a catastrophe during lockdown. Luckily, a lot of these challenges are being worked through with greater access to technology via schools, local councils, and the government.

Teachers and trainers are working hard to alleviate the pressures of different learning styles by using remote access to modify their teaching methods and include things like video links shared from their screen to the class as well as giving their students/trainees flexibility to get their work finished in a way that works best for them.

As a second barrier, one has to consider **the lack of support towards the students by their family environment**, as remote learning is not rooted in our educational culture yet.

> *It becomes challenging for learners to keep learning and stay connected in a comfortable online learning environment (Muthuprasad et al., 2021). In Scull et al. (2020)'s engagement study of Australian university students, they found that students need more guidance on how to ask the right questions and seek help in an online learning environment. In taking distance education courses, major concerns such as time management, motivation, and language skills should be considered (Fidalgo et al., 2020). As a result, teachers and school administration at all education levels should seek possible ways to overcome the second-order barrier to further assist the parents and students.*

Another significant factor that must be overcome is the need to **manage distractions** due to remote learning. No matter how disciplined the students/trainees may be, handling all the distractions of a non-office environment can be tough for anyone. They have to get used to working in their own home and still stay focused on their tasks - and feeling guilty for finding their mind frequently wander off-.

Another thing people tend to underestimate is **the feeling of isolation** when working remotely. You don't have your colleagues around you to ask a quick question and you probably won't meet anyone at the coffee machine to have a little social chat. The isolation of working from home can become a big issue, so knowing how to break out of it and engage with people, even if they are not in the same room, is crucial for a happy and full work life.

Last but not least, **keeping a balanced work-life situation** is probably another challenge when working remotely that should not be underestimated. Many employees who work from home feel obligated to work harder and longer hours than their office counterparts. This can lead to a lot of over-time, weekend work, and whole day schedules spent in front of the computer. Oftentimes, remote workers even feel the need to leave their communication tools running at all times and respond to emails immediately, which makes them be alert even when they should be taking time off.

Remote education isn't going away. We must be optimistic and, above all, practical, critical thinkers, and always prepared for finding solutions to challenges that appear. A strong, secure, and accessible remote access solution needs to be in place for all educational institutions around the world.

And while we cannot solve the inequalities of digital exclusion, once students and educators have access to a device at home, remote learning becomes a lot easier with the addition of remote access. One thing is for sure: the pandemic will have a lasting effect on the way we communicate or accumulate knowledge and work experience.

6.2 HOW TO SUPPORT STUDENTS DURING VIRTUAL WORK.

Here are some of the solutions that contribute to remove some of the obstacles and make online education more accessible to every student/trainee:

- Free data to families in need, provided by the government in partnership with leading mobile networks.

- Electronics, provided by educational institutions, as well as printed resources.

- Collections of second-hand laptops and tablets from charities and community groups, to be distributed to students who need them.

If students are still being given the tools for academic success online, systems like remote access can continue to advance such achievements.

What actions should the center carry out to favor the inclusion of these students during virtual internships?

The educational center needs to discover ways to better support and manage remote employees in its level. Although it may be a bit tricky, the following ideas are narrowing it down to these must-have skills or work environment situations.

1. Set Clear Expectations.

> *Everyone has a different idea of what doing something "quickly" or "well" means to them. Ensure you communicate your expectations, whether it be syncing your calendars with your team members or showing specific examples of what you expect to be done. Not only will it ease the* transition from office to remote work*, but it also keeps all employees on the same tier of expected productivity.*

2. <u>Treat remote team members as if they were on-site.</u>

Make sure your remote employees have as much access to you as the ones you pass in the halls, eat lunch across from, and who you see at the water cooler. When remote employees feel like they're barred from having the level access to you that's allotted to on-site workers, they can feel distant and their work can suffer.

3. <u>Trust your team and give rewards</u>

When transitioning from exclusively in-office employees to remote workers it's important to manage your expectations and stay focused on the big picture. Train yourself to worry less about what's being done on a micro-level, instead concentrate on what's being accomplished. If your team is meeting the goals you have set, that's great. If not, that's when you can look closer into what exact aspects of your remote team are lacking. More often than not, it's a communication issue that can be solved with an open dialogue between you and your remote employee.

4. <u>Focus on goals, not activities</u>

Some companies are hesitant to embrace a remote workforce because they're uncertain about whether or not the work will be completed at the same level as if they were in office. In fact, a two-year Stanford study showed that [remote employees were twice as productive](#) as their in-office counterparts. To combat this fear, set up [Remote Work Guidelines](#) that you feel comfortable with, such as emails must be responded to within 24 hours and texting for urgent matters. These can also be incorporated into a [Remote Work Policy](#). Once these guidelines are communicated with your remote team, you'll feel more comfortable with their [absence from the office](#).

5. <u>Schedule video-based coaching on an individual basis.</u>

On-site connection is important, especially with remote employees. If you don't schedule times to talk with one another on-site, silence can become very loud and remote employees might end up wondering how they're doing. Scheduling a regular cadence of video calls can help you stay connected, and video conferencing is [30% more effective for communication](#) than audio-only setups. Make sure you use video conferencing technology, like the [Meeting Owl Pro](#), to help your virtual conversation feel inclusive and more natural.

6. <u>Prioritize Relationships</u>

Team building is important for any team, remote teams are no exception. The best managers go out of their way to form Personal bonds with remote employees. They use appropriate check-in time to ask about employees' families and hobbies. Allow time at the end team video conference meetings for open, casual conversations that the whole team can use to create, strengthen, and sustain those personal connections that are necessary to keep a company functioning at the highest levels.

For many educators, managers, and team leaders, the sudden shift to remote work meant entering an uncharted territory. Confronted with new leadership challenges, they have to find ways to make remote work function properly, often with little or no prior expertise in this field. However, what makes a great remote leader? What skills do remote team leaders need?

Some of the key attributes of a remote team leader are:

- **Empathy**: a great remote leader needs to acknowledge the challenges faced by remote workers, be understanding and listening to them, put themselves into their team members' shoes.

- **Attentiveness**: with the physical distance that comes with remote work, leaders have to be more attentive and observant than ever on potential issues or problems faced by their employees.

- **Flexibility**: a good remote team leader is flexible to cater for different employee needs and adjust accordingly.

- **Trust**: it is necessary to exhibit the ability to show trust even when mistakes are made.

- **Motivation**: keeping remote employees engaged and motivated is more difficult compared to working in the office and even the leaders themselves must persuade their team members that they are highly motivated and set an example for them.

Useful links:

https://www.realvnc.com/en/blog/how-to-use-remote-access-to-overcome-barriers-to-online-Learning/

https://dochangeright.com/five-employee-biases-that-can-make-or-break-your-hybrid-working-model/?gclid=CjwKCAjw9suYBhBIEiwA7iMhNA_98ub64isinOPUNoFVtwF04agqeB2IUwMfbkYmTRGvFelAz1FUChoCSsMQAvD_BwE

https://www.lano.io/blog/remote-leadership-how-to-successfully-lead-remote-teams?gclid=CjwKCAjw9suYBhBIEiwA7iMhNFB1X8RdHOcBjl4-vPwQAHCMEwmT1zYDyzzed1DsO_asglx0YWBrMBoCEfQQAvD_BwE&utm_content=text_582553546993&utm_term=&utm_medium=cpc_Search&utm_source=google&utm_campaign=220101_google_16252924691

https://about.gitlab.com/company/culture/all-remote/being-a-great-remote-manager/

https://www.lano.io/blog/3-common-dangers-when-working-remotely

https://www.frontiersin.org/articles/10.3389/fpsyg.2022.928717/full

https://www.cam.ac.uk/stories/digitaldivide

https://owllabs.com/blog/work-from-home-pros-cons

https://www.lano.io/en/blog/13-proven-ways-to-keep-remote-teams-engaged

https://resources.owllabs.com/blog/remote-management-skills

https://www.researchgate.net/publication/309194000_Accreditation_of_Distance_Learning

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METHODS OF ADAPTATION TO THE NEW PROPOSED METHODOLOGY

METHODOLOGICAL GUIDE: THE VIRTUAL INTERNSHIPS IN TECH CENTERS

7.1. ADAPTATION METHODS IN THE TECHNOLOGY COMPANY

The COVID-19 pandemic forced companies to adapt to teleworking as a new method of working. Before the arrival of COVID-19, the numbers of companies that made use of teleworking were much lower. According to data published in Eurostat, in 2018 the percentage of the population working from home in Europe was 5.2%, while in 2020 this figure increased to 12.3%.

El mapa del trabajo desde casa

Porcentaje de trabajadores que trabajaron habitualmente desde casa en 2020*

Leyenda:
- 20%+
- 15-19%
- 10-14%
- 6-9%
- 0-5%
- Sin datos

Islandia: 8,7%

Finlandia: 25,1%
Noruega: 4,7%
Suecia: 7,3%
Estonia: 12,6%
Letonia: 4,5%
Lituania: 5,4%
Irlanda: 21,5%
Dinamarca: 17,0%
Países Bajos: 17,8%
Alemania: 14,8%
Polonia: 8,9%
Reino Unido: 23,1%
Bélgica: 17,2%
República Checa: 7,2%
Eslovaquia: 5,7%
Luxemburgo: 4,9%
Austria: 18,1%
Hungría: 3,6%
Rumanía: 2,5%
Francia: 15,7%
Suiza: 7,4%
Italia: 12,2%
Eslovenia: 3,1%
Croacia: 1,2%
España: 13,9% / 10,9%
Portugal: 14,8%
Grecia: 7,0%
Chipre: 4,5%

* Sobre el total de la población activa (15-64 años)
Fuente: Eurostat

statista

For more infographics: Statista

In the wake of the pandemic, companies opted for telecommuting or hybrid work as a working method. However, for both teleworking and hosting virtual internships for VET students to work, companies must adapt appropriately. They must have the necessary tools that guarantee both the effectiveness of the internships and the development of the functions of each team member. Therefore, it is essential to implement adaptation measures that establish methods of coordination, planning, and that encourage collaborative work.

- METHODS FOR COORDINATING THE STUDENTS' WORK. During a virtual internship of VET students it is very important to have tools that facilitate coordinating and managing the work of the students. There are many companies that today have management software to manage tasks, processes and projects. This type of software increases productivity, improves collaboration, and is an effective mechanism to analyze the progress of a project. Although there is a lot of management software, we recommend the following:

TWPROJECT

This software is a management tool used in both small and large companies, universities, and for training. It allows to manage projects, tasks, activities, track problems, schedule projects, hold team meetings, etc. It has a free plan that allows to make teams of up to five members who have access to various very useful functions for project management.
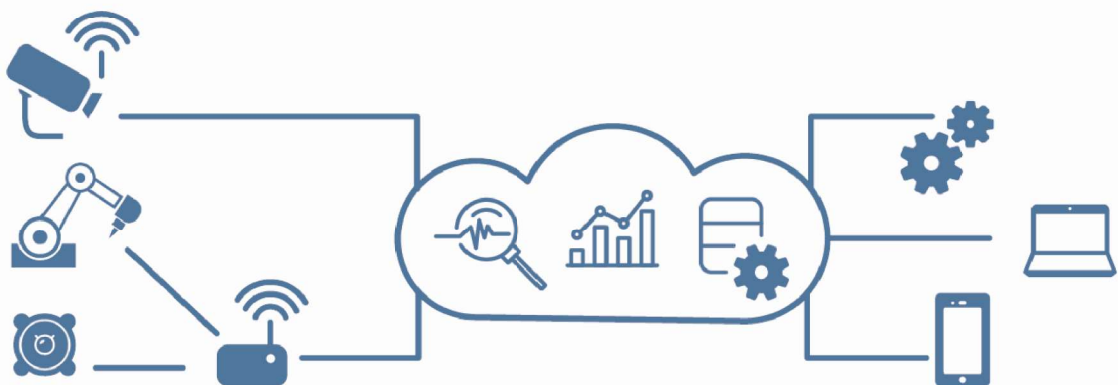
TRELLO

It is a tool for work management in which you can not only manage a project, but also design plans, collaborate on projects, organize workflows and track the project, among

others. In addition to having paid plans that offer a wide variety of features, you also have a free plan for the whole team, which includes very varied options such as activity logs, workspace command executions, storage, power-ups, and up to 10 workspace boards.

- **METHODS OF PLANNING AND MONITORING OF STUDENTS**. It is essential to establish methods to carry out a control of the tasks and functions of the trainees, as well as the dates for making deliverables and completing each task. In this way, we will not only achieve the objectives and deadlines, but that the students learn to adapt to work in a technology company. To do this, the key tool is a virtual calendar such as:

THE APP "ON YOUR SIDE"

A free educational software for smartphones and tablet devices that offers tutors and VET students the necessary resources to carry out, monitor, and evaluate mobilities. It is a very useful tool for the tutors of the technology company to carry out, in a simple way, a daily follow-up of the work done by the students, and can provide comments and information that help the students achieve the objectives of the internship. In addition, they can carry out the final evaluation of the students from the software itself in a fast, comfortable, and easy way.

This software has been developed within the framework of the Erasmus+ project "VET STUDENTS INTO TECHNOLOGY COMPANIES" of the "CRITICALTHINKING4VET" strategic network.

GOOGLE CALENDAR

It is an online calendar management tool with which you can schedule meetings with reminders. Google calendar allows you to keep track of the dates of the planned activities and objectives, ensuring that you keep a constant track of the schedule. This tool will allow the company's technicians to show the students the dates and deadlines of each of their tasks in a clear and simple way, as well as to carry to monitor their work.

ASANA

It is a very useful tool for planning and tracking work that allows teams to organize, manage, and carry out the monitoring of work and projects.

Despite having paid plans, it has a free basic plan for individual users and teams that allows to create unlimited tasks, projects, messages, and activity logs, collaborate with up to 15 team members, and access a calendar with due dates and notices, among others.

- **COLLABORATIVE WORK**. Encouraging collaborative work with students, in addition to being an effective means to promote the development of critical thinking and value the knowledge and work of the rest of the team, generates a spirit of learning, solidarity, and collaboration. Through collaborative work methods one can maintain stable communication, work in the cloud, synchronize documents, access the work done by students, etc.

1. **Communication tools with students.** After the pandemic, most companies established mechanisms that allowed fluid and stable communication between workers. The use of these tools is key to ensure that students who are doing virtual internships communicate with the company's workers and have a full work experience, while keeping continuous collaboration. Specifically, we advise to use free and freely accessible tools that allow all students to use them without incurring an extra cost for them or for the company itself. Some of the most well-known free and useful tools are:

SKYPE

A very useful tool both to hold team meetings with students and to communicate instantly and solve doubts. Thus, it is a free

software that allows to make calls and video calls both individually and in groups, as well as send instant messages and share files between users. In addition to the functions of audio and video calls and messaging, Skype allows to share the screen of your device, which makes it easier for students to present the work done to the rest of the team members and the company's technicians can easily make explanations.

GMAIL

Gmail is one of the most used email services today, which makes it easy to exchange information and contents with the rest of the team quickly and easily.

ZOOM

This software is also used for videocalls and chats, offering a free service with participant limit and call duration. It allows you to create different virtual rooms and sub-rooms to work as a team. It is very useful for large meetings or even remote trainings. Its features and functionalities are similar to Skype.

JITSI MEET

It is a free and open-source system for video calls. It can be used without having to register or install any program on your computer, and it doesn't need to be registered to use it. It can be used from the browser, granting the necessary permissions to it to manage your PC's microphone and webcam.

It is fully compatible with all major desktop operating systems: Windows, MacOS, and Linux. In addition, there are versions for mobile platforms like iOS and Android, also for free. Being an open-source software makes it easy to download and install on your own web server. In this way, an absolute privacy and confidentiality of videoconferences is maintained.

BLACKBOARD COLLABORATE

It is a simple, convenient, and reliable online and collaborative learning solution. It is designed to offer a level of interaction that makes students feel as if they are in the same classroom thanks to collaboration and meeting tools. It acts as a virtual classroom that allows students to interact from their desktop, and can be integrated into various Educational

Technology platforms, including "Moodle". The free version of this application has several limitations, among the most significant is that only meetings of a maximum of 4 participants can be held at a time.

2. **Tools to work in the cloud and synchronize documents**. Making use of this type of tools allows all team members to work on the same project from anywhere, facilitating the work between students and technicians of the company during a virtual internship. When working in the cloud it is important to consider aspects like confidentiality and backups. It is important to know who you grant access to the cloud and the documents to be worked on, as well as to make regular backups that guarantee that the work done is not lost.

Some of the most outstanding tools and with free use options are:

GOOGLE DOCS

It's a simple tool for collaborating, sharing, editing, and creating documents. Google docs is an online word processor that allows to create text documents (format them, insert images, tables, etc.), invite other users to collaborate on the document and modify or comment on it, keep track of revision history, download them to the computer in different formats, and translate them.

DROPBOX

This cloud file hosting service will allow you to work as a team and move forward throughout the project in a coordinated and effective way, since it gives the possibility to store, synchronize, and share both files and folders.

GOOGLE DRIVE

It is an online file storage tool that allows to share work documents with the tutor of the technology company throughout the process of virtual internships.

RECOMMENDATIONS

- **We recommend choosing easy to use tools.** It is important that the tools chosen are simple and intuitive so that students can get used to them easily.

- **Opt for the cloud**. Cloud-based technology has many advantages for collaborative work, as all information is stored online and the activity of each participant can be tracked.

- **Pay attention to confidentiality**. Hosting student internships does not imply that all the company's projects must be accessible to them. However, sometimes they may participate or collaborate on confidential projects, in which case, it is advisable to establish prior agreements.

7.2. ADAPTATION MEASURES AT HOME OF THE VET STUDENT.

7.2.1. Context.

One of the consequences highlighted by the COVID-19 pandemic has been the transformation and acceleration of the digitalization and connectivity of digital services necessary to maintain communication, both social and academic, of students with their teachers, as well as with their fellow students. The tools provided by digitalization have allowed us to maintain the development of student training, once the possibility of on-site training of students in the classroom was reduced and even nullified.

The digitalization forced by the pandemic has increased the various gaps (social, economic, educational, etc.) that existed between students, and this has highlighted the need to create and improve the tools that allow all students to have the same opportunities to develop and complete their training.

It has also been a major challenge for teachers to ensure that students could follow classes from home. Various difficulties were found, not only technical (computer device, communications networks, study spaces, etc.), but also personal (communication skills, organization, concentration, etc.). All this has caused a greater imbalance among students, which means extra work for teachers and more effort for the personalized attention of the students.

One of the problems highlighted by the arrival of COVID-19 was the availability of technology to move the classroom to the student's home. The connectivity and reach of the internet, as well as the speed capability of access to the network has been a great challenge, highlighting the need to cover all inequalities between the availability of this essential service for the training and teaching of students. It has also highlighted the need to increase digital skills among students. The pandemic has accelerated the digital transformation of society and has made more evident the digital gap between students' families.

When students attend a lesson in person, resources are more affordable, and are distributed more equitably, with all students having practically the same opportunities for learning.

The difficulties of the connectivity Not only hinder the ability to compete in a modern economy, but isolate them from the world and lead them to losing the opportunity to receive a good education and training for their professional future. Many students find it difficult to follow the normal rhythm of lessons, suffering from isolation from their peers and preventing them from achieving the basic skills for their social and professional development.

Digitalization and connectivity should be considered common goods to society. This is an essential issue to prevent digitalization from generating even more inequalities.

7.2.2. Mechanisms to adapt a student's home to virtual work.

The obligation to work from home has generated the need to adapt a place in the student's home, to use it as a work and study area. Students have had to adapt spaces of their home (bedroom, living room, kitchen, etc.) into adequate spaces to perform this new task, which implies moving the workspaces of the classroom-workshop to their home.

From the moment it is necessary to work from home, it is more necessary to have an adequate space for it. It is therefore necessary to adapt the spaces of the house to develop tasks that were previously carried out in the study center.

The first thing is choosing the place of the house to work and study.

In general, it should be a place with little noise and distractions, as comfortable and functional as possible. Creating a pleasant work and study environment allows to be more effective during our work.

ADVANTAGES OF HAVING A SPECIFIC SPACE AT HOME ADAPTED TO WORK FROM HOME

- Avoid possible physical and mental health problems.

- It helps optimize the available spaces and resources.

- It allows you to create effective work and study habits.

- It helps us improve adaptation in the face of adversity.

7.2.2.1. Adequacy of the WORKPLACE.

In order to adapt the workplace at home, and that work is as productive as possible, it is best to have a room for exclusive use in the house to work and study. Although in most cases this is not possible, which forces to adapt a part of the student's house (room, living room, etc.) to use it to work from home.

Here are a series of tips that will allow us to turn an area of the house into a workplace:

- Locate the **quietest place** to turn it into the work area. It must be a noise-free place that allows you to concentrate easily. It must have nearby internet access, through wired or wireless connection. It must have nearby electricity plugs, to easily connect the laptop or PC, the smartphone, in addition to all the technology devices necessary for work. Working at home using the internet as a means of communication, without anything failing, is important to have everything well at hand.

— The place must have **adequate environmental conditions** of temperature and lighting. To promote concentration at work, an adequate temperature is necessary to avoid excessive heat or cold. It is also very important to properly see the devices and work area, try to choose natural light or lighting similar to sunlight.

— It is also convenient **to divide the work area from the leisure area**. Once the workplace has been chosen, there must be a clear and effective separation of the work area from the rest of the house. All people who live in the house must know that the chosen place is the student's work area, and that during the working hours they cannot be disturbed. Emphasize this if small children live in the house.

— Look for accessories that facilitate organizing the work area at home. The organization of teams and work tools is very important. If an orderly work area is achieved, it will be easier to focus on the work and make the effort more profitable. In the closest areas, the things that are used more often should remain, and in the most remote those used less frequently.

— Once the work is finished, you should be able to put everything back in place. Pay special attention when the work area is the bedroom or common area of the house. Once the work is finished, it will be easier to disconnect, rest and enjoy free time at home.

7.2.2.2. Adequacy of the WORKSPACE

When designing the workspace of the work area, a series of requirements must be considered, which in general can be the following:

− The arrangement of devices and materials in the workplace must allow changes in posture, avoiding prolonged static postures.

− To allow the student to always work in the most appropriate position, all elements should be adjustable.

− The height of the work plane must adapt to the size of the student, as well as the type of work to carry out.

− The chair must also adapt to the student's size.

− The necessary devices and materials must be at a distance and position as appropriate as possible while also being functional.

If possible, follow these recommendations when designing and implementing the workplace at home:

The WORKSPACE:

The room or work area chosen must have enough space and allow us to change posture and move a bit. It is important that during the breaks one can stretch and move to get relief of accumulated tension and reactivate blood flow.
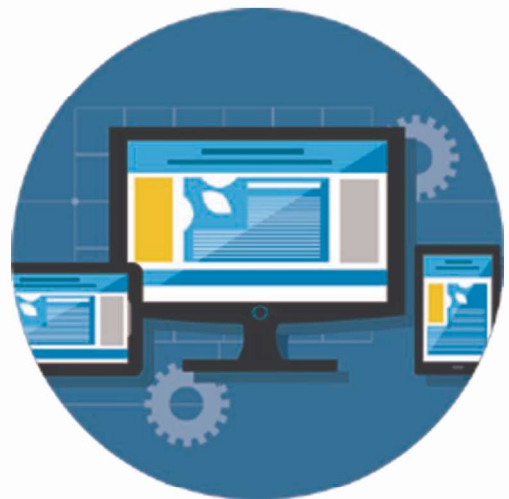
LIGHTING in the work area:

Lighting is a key aspect of the workplace. Good lighting can be achieved with natural light through a window or door. Natural light helps to avoid strain to the eyes, reduces light pollution from com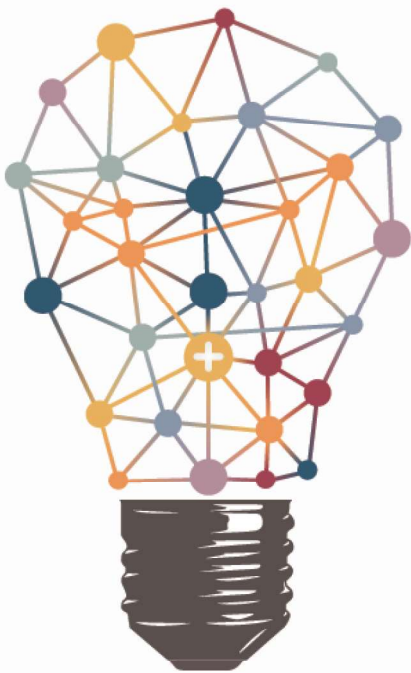puter screens, and reduces electricity consumption. If it is not possible to use natural light, an alternative is to use lighting elements that simulate sunlight. For this, you can use a desktop lamp with the appropriate light in addition to the room's ambient light.

We don't recommend to use localized lights, which greatly increase the lighting of the work area. It is better to illuminate the work area in a general way. This will make the pupil not dilate and contract frequently, thus reducing visual fatigue.

Make sure that the lighting level of the work area reaches 500 lux, with this you will be able to distinguish all objects easily, thus also reducing visual fatigue.

Also, the workspace should have light sources such as windows, but without direct glare nor reflections on the display screens.

ENVIRONMENTAL conditions of the workplace:

The noise level in the work area must be as low as possible to facilitate the necessary level of concentration. It will be located in an area of the house that allows to have a level of insulation against noise. Avoided it being near possible sources of noise, such as air conditioning (the compressor), refrigeration (refrigerators, freezers), the TV or radio.

The temperature of the work area must also be adequate, comfortable, and pleasant. If temperature can be regulated, try to keep it between 24 to 27ºC in the summer, and between 20 to 24ºC in winter. Also, if one can regulate humidity, try to be between 45 and 65%.

ORDER and PLANNING conditions of the workplace:

To work efficiently, the order and organization of the workplace is key. Use shelves, drawers, filing cabinets, etc. to classify and store everything in an orderly and accessible way.

TIPS TO FOCUS MORE IN THE WORKPLACE

- Try to take breaks from time to time.

- When you have a traffic jam at work and you do not get something, take a break and you will see how the mind clears to find the solution.

- On breaks, get up from your chair and walk around the house a bit.

- Ventilate the space every day, it is important to renew the air in the room.

- Always have a bottle of water handy, hydration is important.

- Even if you are at home, try to dress every day as if you were leaving home.

- Pick up the workspace, when you're done.

7.2.3. Occupational risk factors.

A risk factor is an element or set of them present in the workplace that can cause a decrease or damage to the health of the student or worker and his/her environment. Many risk factors can be distinguished at work, depending on their causes. The risks characteristic to teleworking and studying from home can have the following causes:

− General workspace risks.

− Ergonomic risks.

− Risks derived from physical agents (lighting or temperature), such as visual fatigue or lack of thermal comfort.

− Risks due to lack of organization or psychosocial risks, which can lead to isolation, stress from work, stress derived from the use of technology, etc.

In remote work from home, pay attention to the following risk factors, taking preventive actions and measures to reduce their probability of triggering health problems in students.
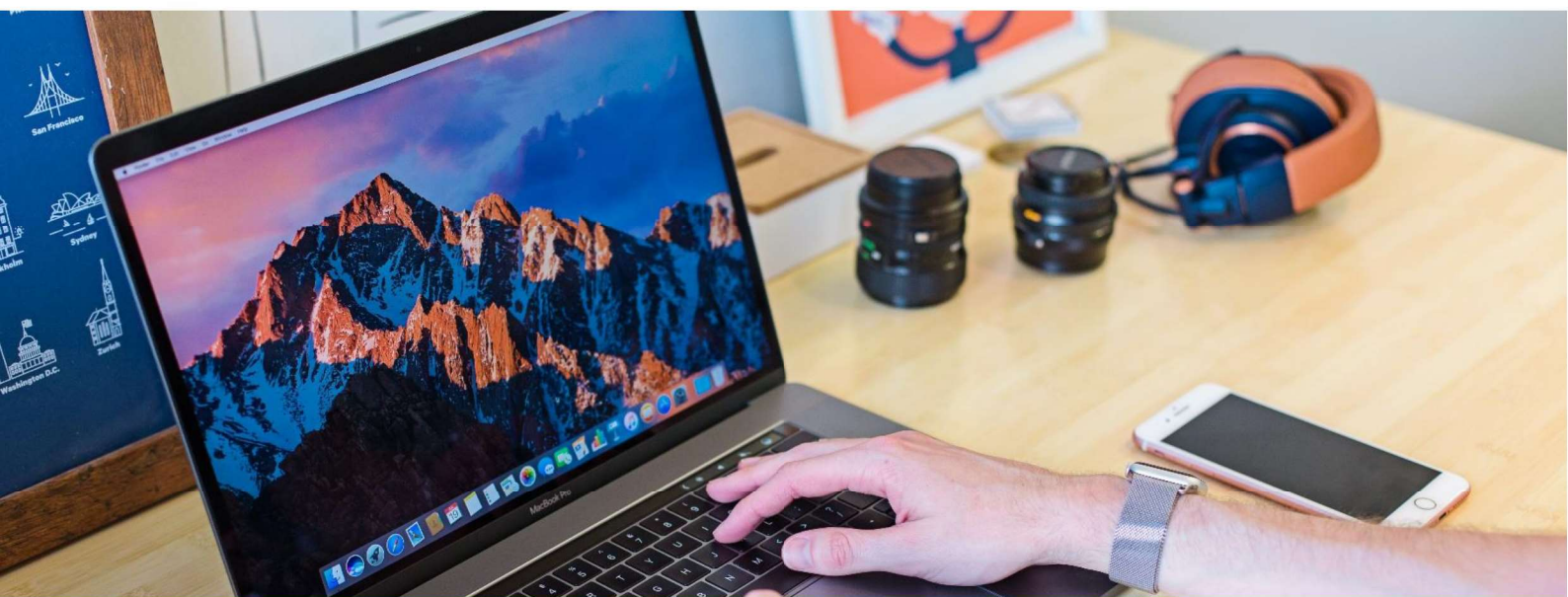
– **Psychosocial factors**. These are those directly related to the organization of work and its social environment, the ability to develop the proposed work, and the physical, mental, and social health of the student.

– **Ergonomic and Organizational Factors**. These are the risk factors for the student's health, caused by the adaptation of a part of the student's home to their workplace.

PREVENTIVE MEASURES FOR PSYCHOSOCIAL FACTORS

➢ Carry out the necessary training for the use of ICTs, as well as all the devices and software necessary for the development of the student's work.

➢ Establish work and rest schedules. Ensure digital disconnection.

➢ Clearly specify the procedure and form of communication between students and between them and the tutor.

➢ Establish an action protocol in case of technical problems when working.

PREVENTIVE MEASURES FOR ERGONOMIC AND ORGANISATIONAL FACTORS

➢ Identify and enable a work area isolated from the rest of the house. Establish a space in the house for the student to have all the devices and materials necessary for their work.

➢ Keep the space tidy to avoid falls or blows, and respect passage areas. An important aspect is the arrangement of electrical and telecommunications wiring. Try to have a fixed installation, avoiding possible entanglements or falls.

➢ Control the temperature and ventilation of the workplace to improve environmental comfort and air quality, creating a safe and pleasant work area.

➢ Organize the schedule of the working day, with the working hours and breaks, to guarantee the days of rest and digital disconnection.

Based on the main risks, the **measures that can be adopted to reduce the risks to the health of the students during their work regarding prevention and protection of their health should be the following**:

A) Muscle-skeletal disorders:

The main ergonomic risks that can affect the student's health come from the work environment itself and the conditions of the home. The factors causing these disorders are incorrect postures, keeping static postures in front of computer screens, and repetitive movements. This makes necessary the correct ergonomic design of the workplace, considering the correct choice of its different elements. The design of the workplace must be adapted to the available space and furniture of the house, which can cause problems arising from posture. To avoid these risk factors, some **ergonomic aspects must be considered in the design of the workplace**, such as:

− **Work table**: an inadequate choice of the height of the work table will influence the possibility of developing musculoskeletal ailments. The work table must have adequate dimensions that allow the student to sit properly and place all the devices and work tools in a comfortable and orderly way, to develop the tasks entrusted to them. As general characteristics, and whenever possible, keep the following in mind:

> ➢ The height must be adequate with the chair, allowing to have the position of the arms as horizontal as possible, thus not forcing excessive flexing of arms and wrists.
>
> ➢ If the height is fixed, it should be of around 67 to 72cm.
>
> ➢ If the height can be adjusted, set it to around 70cm.
>
> ➢ The minimum dimensions should be of 120cm wide and 80cm deep.
>
> ➢ The surface of the table should be matte, to avoid reflections, and not too dark.
>
> ➢ It should allow comfortable placement and change of position of the legs.

– **The chair**: The ergonomic design of the chair must meet the following criteria:

> ➢ The **seat** must be adjustable in height, allowing feet to rest on the ground easily. It should be at least 40cm wide and 38cm deep. It must be padded with flexible and breathable fabric. The anterior edge must be sloped to favor blood flow in the legs.
>
> ➢ The **backrest** must be adjustable in height and inclination. It must also have a surface that allows to rest and support the lumbar area of the back and get the correct support of the lumbar vertebrae.
>
> ➢ The support **base** of the chair with the floor must ensure proper stability of the chair. For this, it will have five arms with wheels, to allow adequate freedom of movement regarding the table.
>
> ➢ It must include **Armrests**, adjustable in height.

– The **Keyboard** should allow the student to adopt a comfortable posture that does not cause fatigue in hands and arms. It is recommended to use **wrist rests**.

> ➢ It must be able to tilt, to allow having a comfortable posture and thus avoid fatigue of the arms or hands.
>
> ➢ It should be easily repositioned and independent of the screen, to allow moving it depending on the task to carry out or the posture of the student.
>
> ➢ It should be as flat as possible, to avoid movements that force you to flex your wrists for a long time.
>
> ➢ It must be placed with enough space in front of the keyboard (about 10cm), to support arms and hands. The wrists must be supported at all times.
>
> ➢ The surface of the keyboard should be matte to avoid reflections.
>
> ➢ Symbols and letters should be sufficiently highlighted, clear, and easily legible. Preferably dark characters on a light background.

– The use of a **lectern** is recommended when printed documents are used. It is convenient to place it right next to the computer screen, and at its same height, to avoid making continuous movements or head turns.

– The **footrest** has an important utility if the table or chair used does not have height adjustment, since it allows, especially short people, to avoid inadequate postures, allowing a correct support of the feet on the floor. It must have a non-slip surface.

Also, to avoid possible musculoskeletal injuries caused by excessive sedentary lifestyle, **a series of exercises should be performed regularly**, like relaxation and stretching: relaxation of eyes and neck muscles, shoulder and back stretching, flexing of joints, etc.

B) Eyestrain:

Symptoms of visual fatigue can occur, when tearing or heaviness of the eyelids, stinging or redness of the eyes, blurred vision, or even cephalea, appears. To avoid these negative effects on the student's health, measures must be taken regarding adequate lighting, avoiding reflections and glare, an adequate quality of the display screen, and a correct location of the computer device and its accessories.

For the student's work at home, it will be necessary to use any type of Data Display Screen (DDS). The use of these screens can cause eye discomfort in users. To avoid visual fatigue due to the use of DDSs, follow these recommendations:

– Choose good **lighting**, will allow you to have good visual comfort and visual perception. Lighting should preferably be natural light, although if this alone is not enough, it should be complemented with artificial light to achieve the appropriate visibility conditions. The following recommendations should also be made:

> ➢ Avoid glossy materials and dark colors in work surfaces.
>
> ➢ When using natural light, ensure that the windows have adjustable protection elements to avoid glare and to control the heat caused by the sun's rays.
>
> ➢ The workplace will be located so the student's vision is not in front of spotlights of the light sources, both natural and artificial, to avoid possible direct glare.

— Avoid **reflections and glare**. To do this, a correct location of the computer device and other accessories will be used, avoiding placing them against the light. If the proper location of the devices is not possible, intense light sources must be shaded by covering them or placing a light filter between the source and the person, so the reflection of the light on the screen or the direct glare on the person can be prevented.

— The **display screen** must meet the following characteristics:

> ➢ Place it so the display work area is continuously at a height that allows the angle of the line of sight to be between the horizontal and 60º below it.
>
> ➢ The horizontal distance from the user's eyes to the reading screen must be between 40 and 55cm, depending also on the size of the screen.
>
> ➢ A suitable quality screen should be chosen, to produce a stable image without flashing or scintillation. It should allow easy adjustment of brightness and contrast between characters and wallpaper to adapt the viewing conditions to the brightness conditions of the working environment.
>
> ➢ To eliminate glare, choose the right location, so that the light is received from the sides, avoiding light sources in front or behind it.

C) Derivates of the Organization of Work:

The student's work from home will take place mostly isolated from the rest of their fellow students and work, and probably in solitude at home. The student will have an exclusively telematic contact (videocalls, phone calls, chat, etc.), hindering the development of group work. This can cause different psychosocial risks that can affect the health of the VET student, which can trigger different pathologies.

Not having an established work schedule and having to use the same physical space to work, study, and live are some of the factors that alter daily rhythms, which can cause stress. Here are a series of recommendations that can reduce health risks derived from the organization of work:

- **Enable an isolated area of the house** specifically to work. The area must have enough space to contain the necessary devices and work materials in a comfortable way.

- The **workday must be properly organized**. Plan the tasks to carry out and establish a schedule with the time dedicated to work, and that dedicated to rest. This will help to control the workplace itself, avoiding overloading it.

- Establish guidelines for **breaks at work**, prioritizing short but frequent breaks over long, time-spaced breaks. This avoids reaching fatigue, since once this happens, it is difficult to recover.

- **Establish a meeting schedule** with the tutor and with the group of co-workers. This will give you news on the development of the work of other classmates, a closer guidance by the tutor, of the rhythm of work being done. This will reduce the feeling of isolation produced by exclusively telematic communication, increasing the feeling of belonging to a group, thus reducing the problems derived from this to the VET student.

- Control the **environmental conditions of the workplace**. The conditions of comfort and environmental quality help to keep healthy and improve concentration and well-being

- **Pay attention to personal appearance**. We recommend to dress as if you were going outside, avoiding wearing household clothes. This helps having a better feeling that a work task is being performed.

- **Respect sleep schedule and others**. We recommended to sleep about 7 or 8 hours a day, always with the same rest schedule, and controlling that necessary conditions of reduced noise, dim light, etc. are maintained to better use sleep hours.

- **Do physical exercise on a regular basis**. This will help maintain fitness and improve mood and mindset.

- Similarly, during breaks you should try to carry out **deep breathing exercises, meditation, and muscle relaxation**. This also helps to better cope with the development of the student's work.

- **Pay attention to the digital disconnection** after the daily work is finished. Outside work hours, don't use the devices to continue working, and avoid tracking notifications from work-related APPs.

D) Derived from the transformation of part of the house into a work area:

Since it will be necessary to adapt an area of the student's home as a work and study area, it will be necessary to pay attention to the habitability of a big enough space for the installation of all the necessary devices, avoiding possible falls and blows, maintaining an adequate temperature, as well as ventilation of the dedicated work area.

7.2.4. Communication.

During the work at home by the student, it is very important to use different computer applications that allow to communicate with one another and thus transmit the necessary information and knowledge, that the students can check the follow-up of the work done, and to offer the student the necessary guidance in the solitude of their work from home.

In order to achieve correct communication with students, it is necessary to use different computer programs, both general communication and contact, and specific for the work to be developed in the virtual internships that the VET student will carry out.

For the use of information and communication tools, is necessary for the student to receive initial training in the use of these applications, since technological advances occur very quickly, and the student must be familiar with the use of these tools.

In the planning and holding of meetings and telematic talks with students, try to follow a series of recommendations:

− Hold scheduled meetings to help with possible doubts, and review the development of the work. In these meetings, connection schedules must be respected, in addition to creating a schedule so that they are carried out periodically.

− Communications will be made in a specific way, for individual tutoring and solving of doubts. They will be requested by the student, to solve specific doubts that arise in the day-by-day of their work.

− We recommend to record all meetings to review the doubts and explanations made, once the meeting is over.

7.2.4.1. Methods for communication with students:

The use of videocalls and online talks for communication with students allows us to carry out different tasks during tele-training:

- Help the student in the orientation and training of the work to do.

- Offer the student a personalized guidance and tutoring.

- Carry out a more personalized follow-up of the training you are receiving.

- Provide a method for the evaluation of the teaching-learning process.

Different forms or methods of communication with students can be used to achieve the objectives mentioned above. Among the different forms of communication, some are:

- **VIDEOCONFERENCES:**

Videoconferencing is a computer service that allows communication between different groups of people. It basically consists of interconnecting a variable number of people through interactive sessions, so they can see and talk to each other.

A videoconference allows to achieve synchronous (live) communication with the student, by transmitting image and two-way sound during communication, both of the student and teacher.

- **CHAT:**

A chat is an instant messaging service used for the immediate communication to two or more people, allowing them to write conversations in real time. Users share a common program over the Internet, in which one types what they want to share in a text box.

The applications and software used to hold talks with students allow to communicate with students through written messages, to which photos, audios, videos, etc. can be added. These applications are developed to be used through mobile devices (phones, tablets, etc.), but there are also desktop versions that allow them to be used with PC operating systems (laptops, desktops).

7.2.4.2. Tools for VIDEOCONFERENCE and CHAT:

The freely distributed computer tools that can be used to carry out videoconferences and/or chats are indicated in section 7.1.
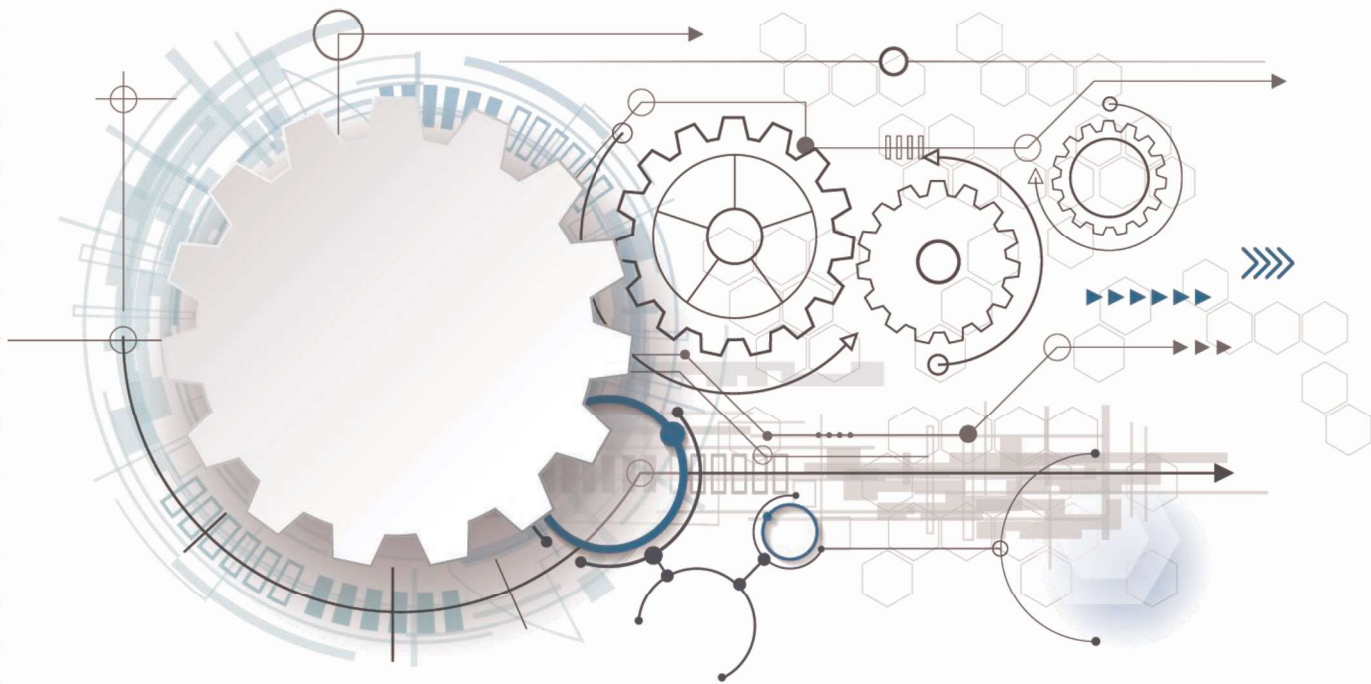
7.3. ADAPTATION MEASURES AT THE VET CENTER

Hora, M. T., Lee, C., Chen, Z., & Hernandez, A. (2021) through their analysis of online internships *amidst the COVID-19 pandemic in 2020–2021* have enlighten that "*online interns have significantly lower levels of satisfaction with their experience for both academic and developmental value, lower levels of acquiring new 21st-century skills, and less growth of professional networks than students pursuing in-person internships*". Regarding the job-related skills: "*fewer online interns report being engaged in high-skill supervised work than in-person interns (31.9% to 40%), which is one of the core ideas of experiential learning*".

This emphasizes that, being one angle of the tripartite relation structuring an internship, and at the same time responsible for academic achievements of the learner, the VET center needs to be well prepared on different levels, but we also believe that it is its duty to take actions in order to prepare the company and the learner for a successful and satisfactory experience.

Besides applying academic knowledge to real work situations and developing the related professional skills and competences, it is expected that interns develop transferable skills particularly useful nowadays (like teamwork, problem-solving, communication, or leadership), professional networks, and that the internship facilitates their socialization as well as getting their first job.

Thus, the role of the VET center in developing the virtual internship goes beyond ensuring that the vocational skills part of the competence reference framework of the certificate are developed: personal and career development need to be fostered.

7.3.1. What makes a work experience a successful internship?

The US National Association of Colleges and Employers has determined the following set of criteria to be met to ensure that an experience -whether a traditional internship or one conducted remotely or virtually- is educational, and thus eligible to be considered a legitimate internship:

1. *"The experience must be an extension of the classroom: a learning experience that provides for applying the knowledge gained in the classroom. It must not be just to advance the operations of the employer or be the work that a regular employee would routinely carry out.*

2. *The skills or knowledge learned must be transferable to other job settings.*

3. *The experience has a defined beginning and end, and a job description with desired qualifications.*

4. *There are clearly defined learning objectives/goals related to the professional goals of the student's academic coursework.*

5. *There is supervision by a professional with expertise and educational and/or professional background in the field of the experience.*

6. *There is routine feedback by the experienced supervisor.*

7. *There are resources, tools, and facilities provided by the host employer that support learning objectives/goals."*

The VET center has a key role to play to ensure that these criteria are met.

Maybe we can go further by stating that virtual internships will bring additional benefits, in particular regarding what are often called the 21st Century employability skills. According to Briant and Crowther (2020), "*the potential benefits include:*

- *Improved equity for students who may otherwise not be able to participate in workplace-based internships (Franks & Oliver, 2012; Jeske, 2019).*

- *Greater diversity of activity types; not limited to workplace-based activities (Medeiros et al., 2015).*

- *Better suited to small industry partners (as is typical in the creative industries) so greater number of industry partners can be involved (Bridgstock, 2013).*

- *Flexibility of time; not restricted to normal working hours (Vriens et al., 2010).*

- *Scalability of the program; easier to expand the program.*

- *Increased student agency; students must operate more independently and be more proactive in their learning, as opposed to traditional employee-like roles (Medeiros et al., 2015).*

- *Reduced attrition, largely due to the increased flexibility of activity and timing.*

So, it is up to the VET center to ensure that the virtual internship is both successful regarding traditional work placement criteria while bringing the added value brought by a distant relation.

7.3.2. Building a portfolio of companies open and prepared to virtual internships

a) Within the existing network of companies:

Despite the development of teleworking, not all companies are prepared, familiar, or willing to provide virtual internship opportunities. They may think that they would not be able to provide the necessary tutoring or that managing a distant intern would create too much additional work with the difficulty to evaluate the progress, process and result, off-site evaluation requiring a stronger formalization of procedures that often rely on a certain level of informality when implemented in a context of physical presence.

If within the existing network of companies, some don't think about the possibility of welcoming distant interns, it is the role of the VET center to demonstrate their feasibility, by:

- Convincing, if needed, the company of the value of virtual internships, possibly providing examples, case studies or testimonies of employers having already implemented them.

- Assuring the company that it will be assisted during the whole duration, making sure that the learner brings a useful contribution. This assistance includes a unique contact teacher who will prepare and follow the internship in collaboration with the company tutor and the student, the provision of communication tools and monitoring documents to assess the progression and the achievement of learning objectives.

b) Enlarging the network:

There is a growing offer of virtual internships online, directly from companies that use the social networks to disseminate them, including offers coming from specialized brokers. The VET center has the responsibility to assess a proposal that would have attracted the student's attention. Before a deepest contact with the company, a first check can be made on the following criteria:

- Description of the job, activity and tasks (is it clear, coherent, detailed, time-bound, is it adapted to the skills and competences of the student, not too low, not too high).

$-$ Explanation of the support provided (both human and technical).

$-$ Proposed compensation.

c) Reaffirming its role as a tutor and as an expert:

As in traditional internships, the company needs to be aware that the VET center will be constantly available to provide support during the internship, both to tutor and follow the student but also to bring a pool of expertise that may not be present within the company. Teachers will present distance-wise to bring their expertise and lead the student to find solutions to the issue raised by the contents of the virtual internship. As for on-site internships, the company can rely on the competences brought by the VET center.

d) Assessing the virtual internships:

A final evaluation of the satisfaction of the learner experience will allow to confirm or not the possibility of continuing to maintain professional relationships with the company as a structured framework for virtual internships. We suggest proposing satisfaction surveys based on a five-point Likert scale, (with "1 = not at all" to "5 = a lot") about the following topics:

- Acquisition of key transversal skills like teamwork, problem-solving skills, communication skills, and leadership.

- Expanding of professional networks, personal development, academic value, and career value.

- Professional support from the tutor in the company (mentoring: direction and feedback about task performance and career planning).

- Personal support from the in-company tutor (do they care for their well-being? do they feel respected?).

- Overall satisfaction with their virtual internship.

Drawing an implementation plan

A successful virtual internship program relies on an effective implementation plan. Adopting virtuality implies for the VET center to develop its working strategy as early as possible in order to be able to support the trainee before, during and after the internship, and be dedicated to its success.

Once the first contacts with the tech center are taken with a global agreement on the principles, goals, and schedule, the implementation plan can be summarized by the diagram below:

Tech Center context → Topic of the internship → Learning objectives → Assessment tools and methods → Internship design → Activities and tasks to be performed

Determination of a tutor → Internship design ← Selection of communication Tools
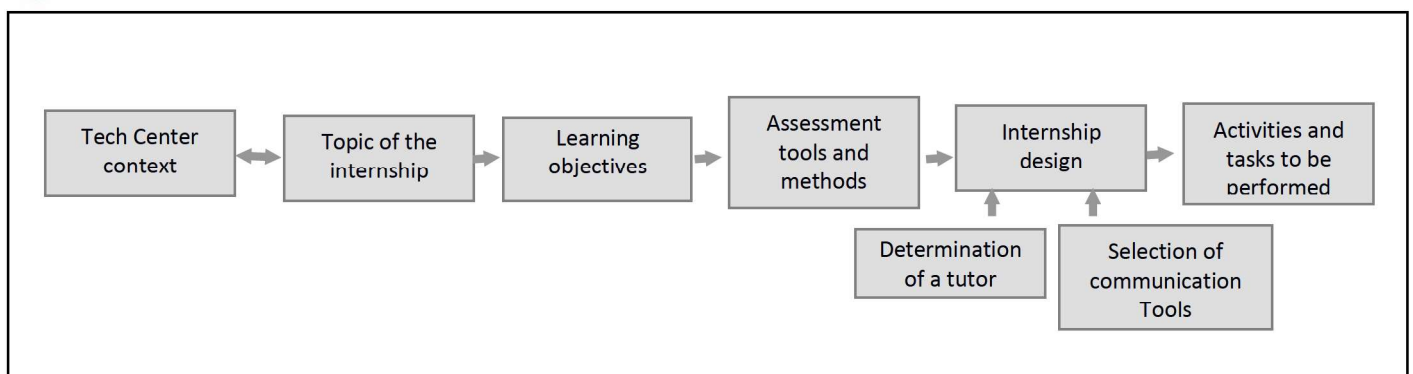
Determining the topic

A virtual internship in a tech center is based on problem-based learning or on case-based learning methodology, with the characteristic that it is defined from a real situation, not hypothetical, emerging from the need of the company. The problem or the case to solve is formulated by the company, possibly with the support of the teacher and better in collaboration with the learner.

The problem or the case has to be motivating, interesting and meaningful. The learner has to research, analyze, and reflect to understand and find solutions. He has to involve himself, to develop critical thinking, to interact, discuss, and test his knowledge, skills, and attitudes during the internship.

The problem -the topic of the internship- should be defined as precisely as possible with the support of the VET center, which is able to assess if it matches the actual skills of the

student. The problem may allow multiple solutions or various models of solutions, but it is still expected to lead to a solution. It is supposed to have different criteria for the evaluation of the solutions, it may have uncertainty about concepts, principles or rules necessary for the solution, and ask students to formulate judgements and to defend their way to tackle it.

Section 8 has models of virtual internships created by the technology companies of this project, as well as a generic model that can be adapted to any job.

Determining the learning outcomes

Ruggiero and Boehm (2016) found that principles of effective design that applied to on-site learning were particularly important for a virtual internship. These included the need to articulate learning outcomes prior to creating the internship (i.e., backwards design), pre-internship meetings with all the stakeholders to identify performance goals, and facilitating peer communications among students. Ultimately, the authors found that, *"explicit, clear communication between clients, mentors, and interns during the virtual internship led to secure attachments and internships that ended in completed projects meeting all of the criteria"* (Ruggiero & Boehm, 2016, p. 117).

Similarly, Bayerlein (2014) argues that internship designers should take a backwards design approach for virtual internships, where the desired skills are articulated and then intern tasks and assessments are identified.

A synthetic written document

It is the responsibility of the VET center to provide students with a written document outlining the learning goals and activities for their internship. It will specify the precise goals for the experience, how the internship will bridge academic concepts with real-world applications, what will be evaluated and how, and expectations for the three parts.

In Annex A and D, two checklists will help the VET center to evaluate how well prepared is the virtual internship from the VET center side and with the tech center.

7.3.4. Preparing the interactions

The lack of in-person interaction emphasizes the need for regular and effective communication. Mastering the art of conversation and digital negotiation is necessary for the VET center to communicate with the students. Web conference tools become the tools of the trade: laptops, tablets, and smartphones. During the internship process, webinars and meetings with the trainees are necessary to learn more about remote work best practices, and to check-in on the trainees that the virtual internship is going well and is a beneficial learning and career-enhancing experience. If there is a group of virtual interns in the VET center, these webinars allow them to interact with each other and share online training experiences.

Preparing the teacher

It is up to the center to evaluate with the teacher who will act as the reference person if he/she has the capability to carry out the expected role properly. Checklists as suggested in annex C can be used for it. The teacher might not be fully confident in their capability to tutor an online internship; if it is the case, another role will be provided by the VET center: to act as e-tutor to follow the virtual internship, organizing and maintaining the communication flow between the tech center, while the teacher will remain in charge of the academic side and the assessments in collaboration with the tech center and the student.

Preparing the teacher for distance is all the more important, since he may have to impulse the communication with the tutor-mentor in the company, if there is no dedicated e-tutor for this role. Even if so, the teacher needs to be able to bring academic support to the student, and their expertise to the tech center. The teacher is who will work with the tech center and the student to prepare the virtual internship in terms of learning outcomes and how to assess them. The teacher/trainer may have to do the following activities (some of them can be shared with or assumed by an e-tutor more dedicated to supporting students engaged in virtual internships):

1. *Define the learning objectives in relation to defining the problem or case.*

2. *Define the assessment of learning outcomes in collaboration with the tech center.*

3. *Guide the learner towards content and research findings, distribute learning resources.*

4. *Establish and show the communication tools that will be used during the internship.*

5. *Establish relationship between e-tutor and learners and between learners.*

6. *Help and support learners having problems with communication tools.*

7. *Present, as a teacher, topics included in the subject -both on-site or online-.*

8. *Coach learners, individually and in groups.*

9. *Foster discussions and exchanges between learners.*

10. *Plan and assess the learning processes taking place within the company.*

Appointing an e-tutor

Effective virtual internship programs of combine learning, training, mentoring, and networking. Here comes the role of the student's tutor (in the VET center). The trainee needs a point of contact within the VET center, who may be the reference teacher, but not necessarily. The tutor enriches the online training experience, they will be the first point of contact for the trainee to ask questions, solve issues, and offer ongoing one-on-one support. The tutor will use many of the same skills as in-person internships and add some additional ones for the virtual format. In the frame of the virtual internships, the tutor:

− Is an open person, close to the learners, whom he tries to know better, encourage, and motivate.

- Takes into account their abilities and their achievements by adapting, if needed, the initial internship plan, proposing to re-organize expected activities and tasks in agreement with the tech center.

- Is familiar with a variety of communication tools and can advise, encourage, and regulate students to use them.

They will work one-on-one with the student and develop a great working relationship with them. Besides preparing the trainee to apply what they learned in the classroom to a workplace and brushing up on their career-specific technical skills, it is important for the tutor to not overlook the so-called soft skills. They include maturity, adaptability, flexibility, tech skills, video call etiquette, professional writing and communication, time management, autonomy, organization, self-motivation, and self-discipline.

The tutor should also usually have a quick and short online catch-up meeting with the trainee, not longer than 10 minutes, equivalent to an online coffee break, to ask how they are doing, how they are progressing throughout the internship, and how they are being monitored.

Preparing the learners

→ **Communication skills:**

This implies training the student beforehand by practicing their communication skills. During the virtual internship, communication with the company and with the VET center may take place via a variety of tools, depending on the preferences and needs, chosen and agreed in the preparation phase: email, phone calls, videocalls, WhatsApp, a dedicated platform…

When using email, for instance, the students will need to learn how to put their intentions into words, how to follow up on requests politely and firmly, how to write a professional response when angry…

When using videocalls, the trainee will need to learn how to remain focused when others are speaking, how to voice out their concerns and suggestions, how to appear professional on video…

Helping the students with all these skills is the responsibility of the VET center.

→ Checking the access to devices and connections:

The VET center needs to make sure that the learner has access to the tools required for work and for communication. Annex B provides an example of a global checklist that can be proposed to the student as a prior self-assessment.

Choosing and organizing the tools

a) Communication tools

There is a variety of tools that can be used to support and keep track of the communication process during the internship. The use of e-mails, videoconference, or phone calls are all effective solutions to maintain a communication flow. The key is to have in-person connections on a regular basis and be able to keep track on what has been discussed. If a teacher prefers phone calls, it is important to schedule regular phone calls with them in addition to other communication methods.

b) Support and follow up tools

To better communicate with the trainees, the VET center can choose an online collaboration platform. It will be the defined virtual space to communicate and exchange regularly. An online collaboration platform ensures that everyone is on the same page and give students a sense of community when they may feel isolated. The trainees will use it to clarify tasks and ask questions that will be stored with their answers and remain visible by all of them. There, the educational center can share educational resources.

Most of the existing online collaboration tools have similar features and provide the same services. Open-source tools will be favored. A research on learning in online courses, whose results can be potentially transferred to virtual internships, shows that students highly value timely feedback, view video-based instruction as useful, and don't require synchronous interactions to be successful in a course (Martin et al., 2018).

This suggests to develop (or to select) a set of short videos on a variety of transversal and technical topics that the students can access prior to the internship or during it: e.g. "Presentation of the e-tutor. How to use the communication platform? Who to contact to solve this or that problem? How to organize a day? How to maintain a healthy life balance when working from home? How to fight the feeling of isolation? The importance of disconnection. Presentation of the assessments". Links to selected short videos for using software and devices (in 3D design and construction, Electronic circuit design, laboratory devices…) can also be provided.

Leveraging the language barriers in an international context

The academic staff in charge of tutoring the student may not be familiar with English or with the languages spoken within the company. This difficulty will be compensated by:

- Using digital translation tools.

- The help of foreign language speakers (other students, a teacher…)

- More time spent to make sure that there is a common understanding.

7.3.5. Annexes

A. Checklist for the VET center (Y/N)

Is there a formal agreement co-signed with the tech center and the student to plan the virtual internship (including topic, objectives to reach, expected learning outcomes, human and technical support...)?

- Have you checked that the tech center is not looking for free or cheap labor?

- Have you checked if the tasks are realistic and achievable by the student, considering their knowledge, skills, competences and the time frame allocated?

- Have you checked if the work to be done by the student is not part of the routine activities of the tech center?

- Have you checked if the skills and knowledge gained can be transferable to other employment settings?

- Do you think that this internship can open doors to the future career of the student?

- Is there an academic tutor named to follow the intern?

- Is the academic tutor well-prepared enough to assist and follow virtual interns?

- Did you set a calendar with regular meetings (at least weekly) with the student?

- Did you plan to organize regular online group meetings to give all the virtual interns the possibility to exchange about their on-going experience and to socialize?

- Did you estimate the daily duration of online activities for the student?

- Can you say that the virtual internship will bring specific skills that an in-person internship would not have brought to the student? Which ones?

- Did you take actions to stimulate and value the acquisition of these skills?

– Do you have an agreement with the tech center on the kind of material that needs to be accessible by the student?

– Can you guarantee the accessibility of these technical resources (software, devices) to the student during the whole duration of the internship?

– Do you know who will be responsible for training the student to an appropriate use of these resources (software, devices)?

– Is there someone able to provide technical support to the student in case of problems during the internship?

B. Checklist for the student (Y/N)

– Do you think you have enough information about the tech center that will welcome your virtual internship, and especially what they expect from you?

– Do you have a timetable set in advance to organize regular check-ins with the VET center to ensure that you are making progress towards the goals?

– Do you know what tools you are supposed to use to communicate with the tech company?

– Do you know what tools you are supposed to use to communicate with the VET center?

– Do you know exactly what is expected from your internship?

– Do you know who can provide you support if you face problems not directly linked to the content of your internship or if you need support and motivation?

– Do you know who you can contact for questions related to the academic dimension of your internship (contents, tasks to do...)?

– Can you preserve a separate workspace?

– Do you have access to technological resources (PC, phone, internet access...)?

– Did you plan to make a written record of your daily tasks and achievements?

– Are you aware that you need to prepare in advance an agenda with the topics you want to discuss with you contact teacher?

C. Checklist for the teacher (acting as e-tutor) (Y/N)

– Do you feel comfortable with supporting distant students in their internship?

– Are you familiar with the use of communication tools?

– Do you know exactly which tools you are going to use for which purpose and at which frequency?

– Did you give an agenda to the student to plan individual meetings for the whole duration of the internship?

– Did you plan to facilitate peer and collaborative learning between students during their virtual internship?

– Do you think you had enough exchanges with the tutor in the tech center (company) to prepare the internship in terms of overall goals and learning objectives and expected outcomes?

– Do you know how you will evaluate, in collaboration with the in-company tutor, the tasks performed and the achievement of learning outcomes?

– Has the overall project been subdivided in tasks that can be evaluated separately?

– Did you plan diverse assessments (written reports, video or verbal pitches, presentation of demonstrators, written reflections…)?

– Did you ask the intern to send in advance the agenda with the topics they want to discuss, possibly prioritizing them, at the regular meetings?

– Did you plan a specific mid-term evaluation?

D. Questions for the VET center to ask to the company (tech center)

- Who will be in charge of the mentoring of the student (transfer of professional skills)?

- Who will be in charge of the integration of the student?

- Will the student be integrated in a team?

- How is the communication within the company organized?

- How long does the student need to be connected each day?

- What possibilities will be given to the student to participate in informal moments?

- Do you plan to associate the student to company meetings so that they can know better the workplace culture and build social and professional connections?

- How is the work asked to the student connected to the activities of the company?

- What software/resources will you put at the disposal of the student for the duration of the internship?

- How will you value the student contribution within the company among the other workers?

- Is there a possibility for the student to be integrated in the company if the internship is a success?

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WORKING METHODS

METHODOLOGICAL GUIDE: THE VIRTUAL INTERNSHIPS IN TECH CENTERS

Here we present a series of examples by the partner entities of the project, belonging to different technology companies. The topics of the internships are focused on the lines of research and development of each of these companies for VET students.

The intention of this section is to provide models of virtual internships that can be used by other companies or even adapted by other sectors.

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MODEL INTERNSHIPS FOR ANY JOB

METHODOLOGICAL GUIDE: THE VIRTUAL INTERNSHIPS IN TECH CENTERS

Adapting long-term internships to virtuality is not easy. Students must correctly understand the work they will carry out throughout the process, as well as the tools and work protocols they must follow. Therefore, we have created a generic model of virtual internships that can be adapted to any job in a technology company, so that company technicians have the means for students to carry out virtual internships.

8.1.1. What are the objectives of the methodology?

The main objective of the proposed methodology is for students to successfully carry out virtual internships that are really useful for their training and for their access to the labor market. To achieve this, we propose as a basis the CRITICALTHINKING4VET and SCRUM methodologies, whose objectives are:

- CRITICALTHINKING4VET OBJECTIVES:

1. Develop the capability for initiative.

2. Develop autonomous management skills at work.

3. Develop critical thinking skills for decision-making and evaluation of one's own actions.

4. Make use of mechanisms to monitor daily work.

- SCRUM OBJECTIVES: The main objective of this methodology is to plan the workflow of a project through the fact that the whole team knows the objectives, tasks and schedule beforehand.

8.1.2. Preparation of the virtual internship document

Next, we provide a step-by-step description of the contents that must be filled in to make an explanatory document to carry out a virtual internship.

8.1.2.1. Introduction and purpose of virtual internship.

First, we will make a thorough explanation of the work they will develop during the internship. To do this, we must explain:

— **Context of the company**. It explains the main characteristics of the company, explaining what its main work consists of, its main objectives, the projects it develops and in which it collaborates, including the departments that compose it.

— **Relevant information on mobilities**. How long will they last? How many students will carry out the mobilities at the same time?

— **The job**. What does the job consist of? What will the students actually do? It is important to explain in detail the project in which students will participate during the mobility.

— **The project**. What is the purpose of the project they are going to carry out? What use does it have for the company?

— **Access requirements**. What requirements are necessary to carry out the virtual internship? It is important to know the conditions that a student must meet to carry out the job and participate in a research project. For example: must they have a specific level of the native language of the country of the company? Do they need a specific level of English? Do they need to have specific knowledge in a specific branch?

Recommendations:

— Draft a document with the most important information of the company and the job so that students can read it whenever they need it.

— Make a previous outline of all the relevant points that you need to explain.

— Meet with the rest of the company's department team to discuss the main points of the virtual internship.

8.1.2.2. Objective.

The objectives of the project carried out during an internship, especially when virtual, must be clear from the beginning, both for the technicians of the technological companies and for the students who are going to carry out the internships.

These objectives must be consistent with the specific curriculum of the intermediate level training cycle of the students who will carry out the virtual internship, as well as establish responsibilities and a degree of difficulty adapted to the competences of these students.

How do you find the specific objectives of the training cycle?

Although there is educational consistency in VET training curricula in Europe, there are large differences depending on the student's country. Therefore, the simplest thing is to contact the student's educational center directly to coordinate these objectives with them. If this is not possible, you can always use the website of the Ministry of Education of the country at hand.

These are the web pages of the participating countries' ministries:

Portugal: https://www.dge.mec.pt/

Spain: https://www.educacionyfp.gob.es/portada.html

Italy: https://www.miur.gov.it/web/guest/home

Greece: https://www.minedu.gov.gr/

France: https://www.education.gouv.fr/

8.1.2.3. Tools needed to carry out a virtual internship.

Students must carry out virtual internships using free and freely accessible tools, as they must have the opportunity to make use of any tool without extraordinary costs or powerful devices. Free software can be freely studied, modified, and used for any purpose, so we encourage the use of this type of software due to its series of advantages, such as:

- It makes it easier for students to work from home legally.
- They generally do not require such powerful devices.
- Licenses are free.
- They are more accessible to any user.

For the proper development of virtual internships, it is important that all members of the group master the management of the essential tools to be used at work. In this way, the work can be effectively distributed, and progress will be made much faster if each component of the group can help the others by transmitting what they have learned.

On the one hand, the company must provide students with a list of the software they will need to carry out the virtual internships, along with a small explanation of each software. For example, for students who carry out 3D design and rendering internships, the company would specify the following software:

1. **- FreeCAD**. This is a free 3D model design software that allows you to produce, export, and edit solid models of total precision, export them for 3D printing or CNC machining, create 2D drawings and views of your models, perform analysis such as finite element analysis or export model data such as quantities or bills of materials.

2. **- Slic3r.** It is a very useful software for 3D printing, necessary to convert a 3D model into printing instructions. Slic3r allows you to cut the model into horizontal cuts (layers), generate toolpaths to fill them and calculate the amount of material to be extruded.

3. **- Ultimaker Cura**. It is a software that transforms the file of a 3D modeled object into sequential instructions to print the figure on a 3D printer.

The company must also provide the user manuals of each software, as well as free access video tutorials that allow the student to understand how to use it. Recommendations:

— Agree with the educational center on specific training sessions prior to the internship.

— Talk to them to learn about the software that students use during their training and adapt the internship to similar open access software to those already used by students.

— On the website of each software you can usually find free user manuals, even tutorials.

8.1.2.4. The working day.

To determine the working day that students will follow, bear in mind that the internships are virtual, and therefore will use the rules of teleworking. Whoever participates in them will have a working day like any other worker of the company, but the work will be remote.

Therefore, the company where the students are going to carry out the internship must specify the characteristics of the working day they will have during the 3 months. To do this, the company must define:

- **The number of working hours**. The company must stipulate the working day that a student will do during the virtual internship. Thus, they must contact the educational center to know the requirements of the students' internship, as established in the educational curriculum.

For example, in Spain, training cycles have a module of studies of training in work centers (FCT) in which they must complete a specific number of hours to accredit the module and finish their studies. Therefore, for a Spanish student who carries out the virtual internships of his training cycle, the company must know the working hours and distribute them weekly and daily.

However, in other EU countries, students do not have to do a minimum of hours, but the importance lies in the number of months of the internship. Therefore, in these cases, the company may decide the number of weekly hours it considers appropriate, in any case not exceeding the maximum allowed in a standard working day.

- **Distribution of the day**. It is important to determine how many hours a day the student will work, and what will be their daily schedule.

- **Holidays**. It is the task of the company to decide whether the student should stick to both the company's work calendar and the educational holiday calendar of their country of origin, or only the company's work calendar.

Recommendations:

— We recommend the student's schedule to be simultaneous to that of the workers of the company involved in the project, so there can be stable and fluid communication.

— In the distribution of the day, is better to not saturate the student. It is preferrable that every day has a similar volume of hours, avoiding days with many hours and others with very few.

— The schedule should encourage the integration of the student in the daily work of the company.

— It is important to communicate to the student about the holidays that they will enjoy. It is convenient to stick to the working holidays of the company, so they don't work in days in which they won't be able to communicate with other team members.

8.1.2.5. Activity log sheets.

When teleworking, the worker is in an environment in which interaction with other workers in the company is limited both in time and distance. Thus, it is absolutely advisable to establish at the beginning of the day an individual work plan for that day and end it with a review of the activities carried out. Below is a sample file that may be useful for this, in which we include an example for an activity.

We propose the following model:

Date:	Worker:	
Planned activities	**Objective. Result to achieve.**	**Comment at the end of the working day.**
Example 1: Group meeting.		
Example 2: Preliminary design.		

These log sheets should be uploaded daily to the worker's individual folder in the shared space.

Recommendations:

— Make a simple file that is easy to understand.

— An easy form with specific sections will make it easier for the student to fill in.

— At the beginning of the internship, do a brief training day in which you explain to the students how to fill the log sheets.

8.1.2.6. Group meetings.

These are meetings attended by all the people involved in the project (students and staff involved in the company). Due to the modality of the internships, these meetings will be held virtually to ensure the participation of all students. To do this, the communication tool to be used must be established: it is important to choose a free and freely accessible tool that can be downloaded by any student without extraordinary costs or the need for licenses. Skype is a good option, since it allows to gather a large number of participants and video calls do not have a duration limit.

Team meetings are important not only to discuss relevant aspects, but also to solve doubts and help discuss solutions for possible problems. Thus, during the meetings we propose to deal with aspects like:

- Distribution of tasks.
- Reports on the tasks performed. The results of the tasks performed will be presented to the team.
- Brainstorming.
- Presentation of the evolution of the activities by each student.
- Discussion among team members.
- Troubleshooting tips.
- Evaluation of the progress of the project.

Since these meetings will be held virtually, it is important for them to be dynamic and effective. Therefore, we propose to determine some aspects:

How often will they be held? The tutor of the company must determine the most appropriate periodicity to hold these meetings. We recommend to hold them weekly, as it allows to have specific topics to talk about while maintaining frequent contact with students.

Although these meetings are held with a certain frequency, it is important to emphasize that students, technicians, and company tutors must keep a fluid and stable contact through the communication tools specified at the beginning of the internship. In the case of work in a virtual environment, it is convenient to keep a fluid dynamic of teamwork in which students feel that they are part of the company's team.

What topics will be discussed? Before each meeting, the company's tutor must set an agenda and send it to all team members.

What structure will they have?

Who will participate in the meetings? Our recommendation is that all those who are directly involved in the project participate in the team meetings, that is, the students, the company technicians and the tutor.

How long should the meetings be? It is important to determine a maximum duration for each meeting so all topics can be discussed. This time may be exceeded if necessary.

Recommendations:

- Don't let the meeting stray from the main topics and objectives.

- Send the agenda in advance so that students can prepare the materials to use.

- Convene meetings when all participants are available.

- Make sure everyone participates.

- Create a climate that promotes the open exchange of ideas.

8.1.2.7. Meetings with the tutor.

These meetings are only between the tutor and each student, to carry out a personalized follow-up and maintain a continuous and stable communication. Like team meetings, these will be virtual through free and freely accessible communication tools. To plan these meetings, the company's tutor must determine:

- How often should they be held?

- What will the meeting consist of? A presentation of the work done to date, solve doubts, critical analysis of the situation of the project?

- How long should they be?

Recommendations:

- Prepare the topics you want to discuss with the student in advance.

- Set a realistic duration that allows you to adapt to your work.

8.1.2.8. The work plan.

When starting a virtual internship, it is essential that students know the work plan they are going to carry out. A work plan is a document that establishes the most relevant information for the organization and realization of a project. In this case, it must be prepared for 3 months long virtual internships.

The work plan we propose consists of 3 phases, in which the activities that students must carry out are specified, as well as their duration, objectives, expected results, and priority.

Phase 1: Understanding the problem.

The objective of this phase is that students have a clear idea of the characteristics of the work to be developed.

First, we propose to hold a team meeting where the tutor of the company will propose to them both the project to develop during the mobility and the working methods.

Secondly, students must be trained in the communication tools and software they will use during the next 3 months. To do this, the company must provide them with the software and user manuals to understand their working and analyze the doubts that arise with the rest of the team.

Third, students should look for information and references about the different materials that the company's technicians use, characteristics, parameters, etc. For this, the information that the company has provided about the project they are going to develop will be necessary.

Throughout this phase, students must carry out a set of tasks that tutors must identify in detail, including the following information:

- Title.
- Description.
- Result.
- Duration.
- Priority.
- Person in charge. Who will participate, the whole group, each student separately...?

They will also indicate what are the tangible results that must be delivered to the company, such as daily worksheets, minutes of meetings, presentations, etc.

Phase 2: Project execution.

This phase is the most important of the internship, because in it they will develop the project that the company has entrusted them with.

We propose the first step to be a preliminary design of the project that the students have to carry out, and to show it to the rest of the company team during a virtual meeting. Thus, they will have the opportunity to discuss the advantages and disadvantages of each design, thoroughly understanding the project proposed to them.

We consider it important that, after the preliminary design, decisions are made based on the analysis, on the design of the project, and on certain relevant aspects. For example, in the case of the "3D design and rendering" job, they must decide on aspects such as the thickness of the pieces, the methods to join the pieces, the most appropriate printing material…

As a result of these steps and the activities they include, students will be able to carry out the final design that they will implement and develop in the project.

During this phase, periodic follow-up meetings should be held both as a team and individually with the tutor, in which students will present not only the progress of the work but also the doubts and problems that arise.

As in the previous phase, it is important to have enough information about the activities that students are going to do. To this end, the following shall be indicated:

- Title of the activity.
- Description.
- Result.
- Duration.
- Person in charge. Who will participate, the whole group, each student separately…?
- Expected results.

–   Deliverables.

Phase 3: Conclusions. Final presentation.

At the end of the virtual internships, students must present a final report showing the results obtained and the set of work they have done. They must also make a virtual presentation to the rest of the team of a maximum duration of 30 minutes.

The same as in phases 1 and 2, the activities will be detailed indicating the same data.

Recommendations:

–   Make a realistic plan that students are able to finish in the time that the internship lasts.

–   There is no certain length for the document, but it must be long enough to have all the relevant information.

–   It explains in detail the activities and phases of the work plan.

–   Visualize the project as a whole.

–   Define the objectives.

8.1.2.8 Timeline.

A timeline is an effective tool for planning, executing, and evaluating a project. To develop one, start from the work plan that has been established for virtual internships, since it specifies the most relevant information to draft it. It must indicate:

–   Start and end date of the virtual internships.

–   Phases of the work plan.

–   Activities included in each phase, indicating the duration.

–   Date of presentation of the deliverables.

–   Periodicity of team meetings and with the tutor.

For example:

Task		Phase												
		Phase 1												
1.1	Activity 1													
1.2	Activity 2													
1.3	Activity 3													
1.4	Deliverable 1													
1.5	Deliverable 2													
		Phase 2												
2.1	Activity 1													
2.2	Activity 2													
2.3	Activity 3													
2.4	Deliverable 1													
2.5	Deliverable 2													
		Phase 3												
3.1	Report and final presentation													

Recommendations:

−   Includes realistic timelines.

- Keep track of the established schedule to be able to deal with possible risks and readjust it if necessary.

- Use the timeline to evaluate the effectiveness of the work done.

- Use a simple and understandable design.

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SPECIFIC MODELS OF INTERNSHIPS

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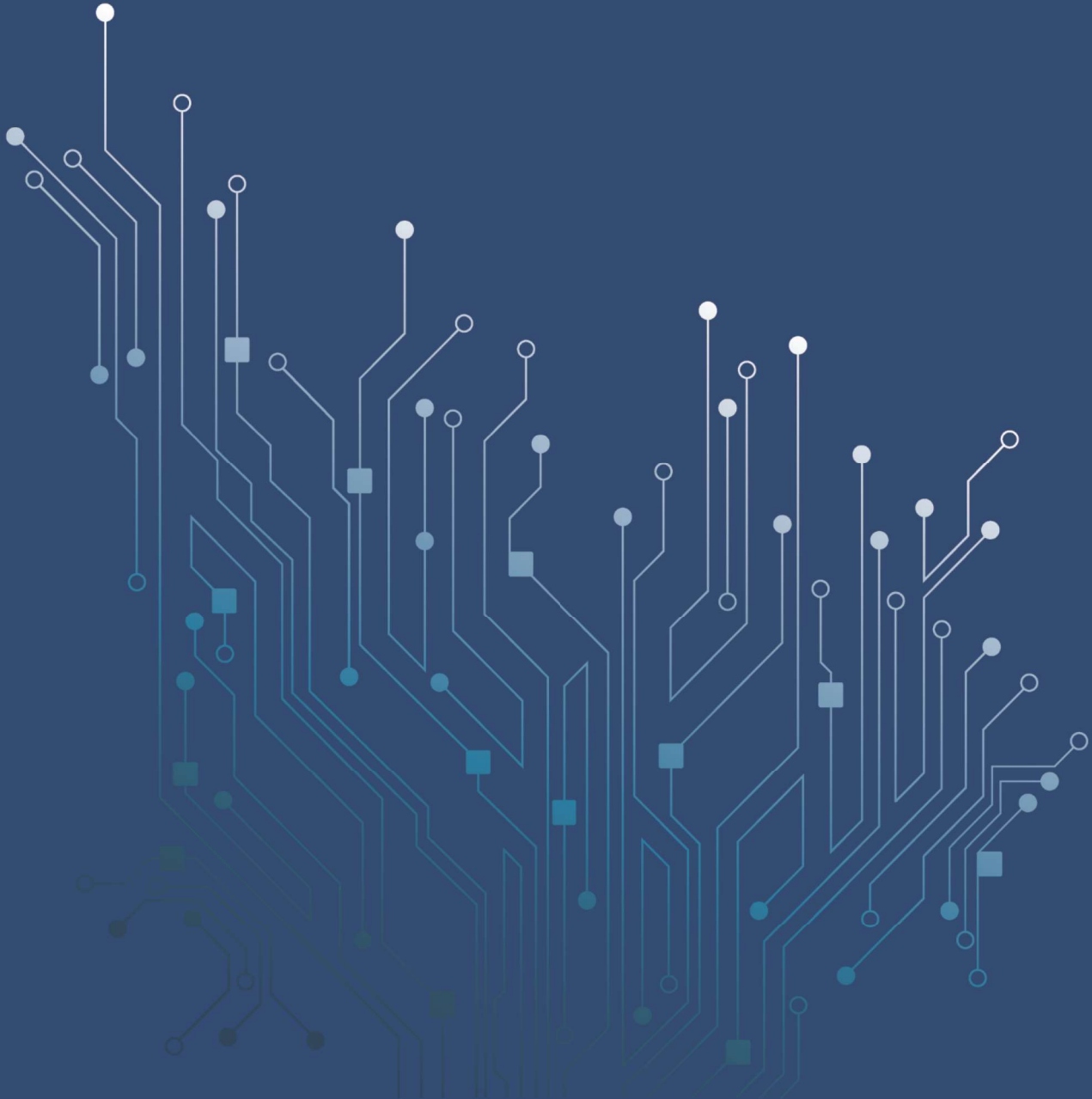
INTERNSHIP MODEL FOR ELECTRONIC CIRCUIT DESING

SOMATICA
MATERIALS & SOLUTIONS

METHODOLOGICAL GUIDE: THE VIRTUAL INTERNSHIPS IN TECH CENTERS

1. Introduction and purpose of the internship.

In our days, most devices use have an electronic circuit inside. Everything from home appliances to music uses electronics or electronic components in some way. The car which we use daily has many electronic components, as does our microwave, TVs, laptop, loudspeakers, smartphones, etc. Using electronics today is so much a part of our daily lives we hardly think of the way the world would be without electronics.

Due to its importance when developing a specific device, the goal of this internship is to teach how to design electronic circuits from scratch in order to come up with a satisfying result.

The work will be carried out by students and supervised by a tutor from the company. This guide will specify the organizational methods, personal and group work methods, computer tools to be used, the planning and control of the working day, the periodic report of results and everything related to the relationship between the worker and the company in the period of development of the internship.

2. Objective.

The objective of this work is to create a tutorial on how to design electronic circuits, so that students can design their own circuits and then implement them in electronic devices. All procedures will be indicated, and some free software will be suggested so that anyone can do it, even with few resources.

3. Teleworking tools.

The work will be carried out using free access software. It is important that all the members of the group master the handling of the three essential tools that are going to be used at work. In this way, the design work of all the parts that make up the model can be distributed effectively, but it is also important because when learning the different tools that these programs contain, progress will be made much faster if each component of the group can help others by passing on what they have learned. Essentially the following software packages will be needed:

1.- Software to design electronic circuits

There are several free software's that can be used to design electronic circuits, such as KiCAD, EasyEDA, OrCAD, etc. These software's have thousands of libraries that helps the creation of schematics designs and can be viewed in different perspectives to allow an easy inspection of the mechanical fit of the PCB and a preview analysis of the finished product.

2.- Software to hold telematic meetings

Tools such as Microsoft Teams, Zoom, Skype or Google Meet we will be used since they are very simple to use and most of the students are already familiar with them.

3.- Office Software

To create slide presentations, to write text documents or create spreadsheets, Open Office will be used. A similar software, such as Google Slides, Docs and Sheet, respectively, could be used. All of these software's are free and easy to use, and also familiar to most students.

4.- Documentation repository

A network documentation storage space will be created by the company, which will be available for the group in order to register all activities and results of the project. Different folders will be created, both for the group and the participants, where they can save their tasks results.

4. The working day.

During this project, all working days will be carried out remotely and, therefore, it will be necessary to outline a good weekly planning in advance so that the results are successfully achieved. This planning should be done jointly, between the company and the workers, in order to increase the productivity and efficiency of the tasks.

The working hours will be flexible, which means that workers will be able to define their work breaks, however they must take into account that the daily work period is 8 hours, and that they must enter at 9:00h. At the beginning of each week, there will be a 1-hour meeting with the objective of defining the work plan for that week, and on the remaining days of the week

there will be a short 15-minute meeting, at 9:00 am, to review the status of the previous day and to adjust the tasks as needed.

In this way, it is ensured that the daily workload is approximately 8 hours, and that the tasks are carried out as planned, and in the event that more time is needed to carry them out, there will be an adjustment, which will be made at the next day's meeting.

5. Activity log sheets.

When working remotely, the worker finds himself in an environment in which interaction with other company workers is limited both in time and because it is telematic.

In this way of working, it is absolutely advisable to establish an individual work plan for each day at the beginning of the day and end it with a review of the activities carried out. Attached below is a model sheet that may be useful in this regard, in which we include some examples of such activities.

Date: xx – xx – 202x	Worker: xxx	
Planned activities.	**Target.** **Result to be achieved.**	**End of day comment.**
Meeting & Planning	Talk about xxx and adjust the tasks for today.	It was clear and a few adjustments were necessary.
Learn the main tools of the software	Get familiar with the tools and test them.	It was good to know the basic but need more information.
Create a discussion in the forum's about a specific software tool.	Register on the platform and ask the questions: xxx and xxx.	It was interesting to get different point of views.

Have a second opinion with colleague xxx from the company.	Ask the questions: xxx and xxx.	The discussion was productive since colleague xxx is an expert in this field.

These files must be uploaded daily to the individual folder of the worker in the shared space.

6. Group meetings.

Group meetings will be held with all elements of the project, where few or many people may be present, depending on the dimension of the group.

- Since the tutor's role is only to guide and encourage the group, it will be important that the group members define among themselves who will carry out the different tasks and how. These and other issues will be discussed in group meetings so that the group is cooperative, efficient and dynamic. Possible issues that could be discussed are:

- Preferences, knowledge and skills of each member of the group.

- Distribution and definition of tasks, in accordance with the previous point, so that the group is more productive in carrying out the tasks.

- Share ideas and knowledge to overcome obstacles throughout the project.

- Analysis of the status of the project, so that they can adjust what is necessary.

- Presentation of the results to the tutor or the company

Note that these group meetings are independent of the daily 15-minute meetings referred to in point 8.3.4. These meetings will be held whenever 2 or more people consider it necessary to have a meeting, in order to expose the matters that they consider important to be discussed. In other words, group meetings can be created between 2 or more people, requiring a prior appointment of the day, time and duration of the meeting. The person responsible for

scheduling the meeting will be the mediator of the meeting, where he must expose the topics that will be discussed so that any member of the group can participate and intervene, since these meetings are totally open to anyone.

In the case of meetings with a lot of people, it would be an asset to have a person who compiles the entire meeting, so that there is a record of it, and can later send it to all participants, and there is a record of it.

7. Meetings with the tutor.

Meetings with the tutor will be held once a week with a maximum duration of 1 hour. These will be conducted by the tutor and a representative of the group, so that they are faster and more productive. In the first 30-45 minutes, a project status will be made showing the objectives and goals achieved to date, the results obtained, the difficulties encountered and possible solutions. This will be supported by a slide show to facilitate discussion. The final 15-30 minutes will be devoted to questions and suggestions from both the tutor and the group members.

In case of need, there may be extraordinary meetings, organized by the tutor or the group, so that the proposed work is adjusted and/or carried out within the stipulated deadlines.

8. Work plan.

In the work plan presented below, an attempt has been made to identify in detail all the tasks that need to be carried out to achieve the project objective. We list them consecutively, with a brief description, the execution time period and the tangible results that must be obtained from them. In any case, the breakdown of tasks may not be complete and during the development of the project new ones can be detected or some of the specified ones can be seen as unnecessary. The group can make the necessary readjustments. There are tasks that must be carried out by all the members of the group, others for which only one of the components can be responsible.

The internship is organized in three phases or work packages.

Phase 1. Understanding the problem. Training in teleworking tools. Preliminary solution.

Task 1.1: Understanding the problem.

The first day will start with a Group meeting with the tutor. In this meeting it will be discussed the problem statement, the objective of the project, the organization and strategies of all the work to be developed, such as: group meetings, distribution of tasks, number of working hours, reports, and more.

Result to obtain: The group should clearly understand the goals of the project in order to carry it out successfully.

Duration: Day 1.

Task 1.2: Software installation on individual computers..

The installation of the software necessary for the execution of the project is very easy to do, just follow the steps indicated by the software itself. If doubts arise, the group members may ask each other how to obtain a solution to the problem encountered, or, as a last resort, they may search on the internet.

Result to obtain: Each person in the group must install and configure all necessary software on their computer.

Duration: Week 1.

Task 1.3: State of the art about PCB design Tools.

An easy way to understand the state of the art of how to design printed circuits boards (PCB) is by searching this information on the internet, more specifically on YouTube.

Result to obtain: A short slide presentation should be created showing the search results obtained, to be presented to the tutor in a maximum of 10 minutes. This document must be uploaded to the "*Name of each member*" folder, within the (Main) group folder.

Duration: Week 1.

Task 1.4: Preliminary design.

   In the second week, after better understanding how to design PCBs, all the elements of the group must think about what they want to design, with the possibility of producing the PCB at the end of the project and, who knows, implementing it in a basic prototype that they have idealized.

   Students with less knowledge should choose simpler designs, as the main objective is to familiarize themselves with the software and its capabilities. Over time, they will gain experience, and will certainly be able to execute more elaborate designs.

   To facilitate the choice of circuit design to be developed, students will be able to browse the many free libraries available in the PCB design software. Here you will find lots of finished drawings and projects, where you can be inspired to come up with ideas.

Result to obtain: To be minimally familiar with the software tools, to be aware of the variety of designs that exist, and to get ideas to create their own electronic circuit design. Your ideas should be materialized through your own drawings or, in the case of performing functions, through diagrams.

Duration: Week 2 & 3.

Phase 2. Project execution. Design and construction of the prototype.

Task 2.1: Specifications.

   The first step to consider when designing electronic circuits is to know what the purpose of the circuit will be. For this it is necessary to know:

- What will the entries be? Will they be analog or digital?

- What will be the outputs?

- Do I need additional blocks such as amplification, filtering, switching, etc.?

- Do I need a microcontroller to process digital signals?

You can draw the idealized circuit on paper and determine what components will be needed. To do this, you must have in-depth knowledge and understanding of electronic circuit design and the various components needed to build a circuit. You should also know the behavior of components under different inputs. These components include transistors, resistors, Op-Amps, etc.

Result to obtain: Students should idealize the intended circuit in advance and analyze which components are needed to implement them. To this end, they should deepen their knowledge of the different electronic components available on the market, in order to choose the most suitable ones.

Duration: Week 3 to 5.

Task 2.2: Circuit schematic.

After defining the components and circuit specifications, the next step involves designing the circuit in software. The software to be used will be one of those mentioned in point 8.3.3 above. After designing the circuit, simulate it and verify that the output and response are the same as you need. You will probably spend a great deal of time in this step, fine-tuning the circuit according to the intended output signal. This step is iterative, that is, you may have to go back to the circuit diagram and adjust it to receive the desired output.

Result to obtain: Become familiar with design software and understand the role of selected components in the performance of the designed circuit.

Duration: Week 5 to 8.

Task 2.3: Hardware implementation.

Before implementing the hardware, it will be important to determine whether the components used in the software are available in hardware or not. For this, it will be important to read the user manual of the circuit components and check the specifications of these components. It is recommended that you consider circuit protection when implementing the circuit.

You can view your hardware output on an oscilloscope to determine if it meets your requirements. The oscilloscope allows you to take screenshots, name them and save them to a USB. An alternative to view the hardware output is to check the datasheet of each electronic component.

Result to obtain: A document with a list of all electronic components that are going to be used, as well their datasheets.

Duration: Week 9.

Task 2.4: PCB design & layout.

After the hardware implementation has been successful, the next step will be to convert the circuit design to a printed circuit board (PCB). Most software automatically provides a PCB when designing the circuit schematic. Print the PCB design in a file so that you can order, in the future, the PCB production in a PCB manufacturing company.

Result to obtain: Get the PCB design in a file.

Duration: Week 9.

Phase 3: Conclusions. Final Presentation.

Task 3.1: Final presentation.

At the end of the project, it will be necessary to write a report that describes all the steps taken, as well as all the results achieved. This document must contain:

- A summary of the entire work, showing the final result.

- Difficulties and solutions found during the project.

- Images of the circuit design as well as the final PCB.

- The file location of all files, including the datasheet of the selected components, specifying the name of each file and the folder that contains it in the shared space.

- A discussion of the outcome, highlighting the project's strengths and weaknesses, future progress that could be made, problems that remained unresolved, and future suggestions.

In addition to the writing of the report, there will also be room for a 30 minutes' presentation carried out by the team, to the staff from the companies and educational centers involved in the project VIRTUAL INTERNSHIPS IN TECH CENTERS: training VET students with obstacles into a innovative digital methods of remote working and e-Learning created from COVID-19.

A short video version of this presentation will be prepared for publication as part of the project's outreach program. In any publication related to this work, the students who have participated in it and their tutor and those responsible for the work in the company will appear as co-authors, as well as the person who has designed their objective and work plan.

Result to obtain: Final report and team presentation.

Duration: Week 10 to 12.

9. Deliverables.

In this section we list the set of documents and other tangible results that must be delivered to the company throughout the development of the project.

All documents and files should be delivered in a specific folder.

The structure is the following:

Group FOLDER

- **Members** FOLDER
    - **Name of each member** FOLDER
        - **Work sheet, files, final report**
- **Meetings** FOLDER
    - **Group meetings** FOLDER
        - **Minutes**
    - **Tutor meetings** FOLDER
        - **Minutes**

D1: Work sheets:

Each member of the group must leave their daily worksheet in their individual folder, creating a subfolder with their name within the group folder.

D2: Minutes of group & tutor meetings:

The compilation documents of the meetings and the slide presentations created and used in the meetings, respectively, will be delivered in the *Meetings* subfolder, with the name of the meeting and date, within the group folder.

D3: Files:

All files created in the electronic circuit design software should be delivered in each member folder with the name of the file.

D4: Final report of the project:

A Word file should be submitted to the folder of each member of the group.

10 Timetable.

		Deliverables											
Weeks		1	2	3	4	5	6	7	8	9	10	11	12
Tasks		**Phase 1**											
1.1	Understanding the problem	▨											
1.2	Software installation on individual computers	▨											
1.3	State of the art about PCB design Tools	▨											
1.4	Preliminary design		▨	▨									
		Phase 2											
2.1	Specifications			▨	▨	▨							
2.2	Circuit schematic					▨	▨	▨	▨				
2.3	Hardware implementation									▨			
2.4	PCB design & layout									▨			
		Phase 3											
3.1	Final presentation										▨	▨	▨

129

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INTERNSHIP MODEL FOR THE DESIGN AND RENDERING OF 3D MODELS

IKASIA TECHNOLOGIES

METHODOLOGICAL GUIDE: THE VIRTUAL INTERNSHIPS IN TECH CENTERS

1. Introduction and purpose of the internship.

"Meccano" is a famous construction toy since the beginning of the 20th century. It's a very engineered toy. It is built with metallic pieces in different shapes: straight rods, curved pieces, or plates with different geometries. These pieces are regularly perforated in multiple positions (figure 1). They were initially metallic, but over the years transparent or non-transparent plastic pieces were incorporated. The pieces are joined with small screws and nuts. A multitude of specific parts required to build the different models are incorporated, as well as parts that allow movement: motors, gear wheels, axles, wheels, pulleys...

Figure 1. Meccano

The toy is indicated, according to the manufacturer, for children aged 7 or over, and children around this age will probably need the help of an adult to make the complicated models. The toy allows to develop the child's imagination and creativity. Beyond the models to be built (for which very precise, step by step, instructions are included) the possibility of joining the pieces in a very versatile way allows children to imagine a multitude of different devices or create imaginative objects.

The defect that the toy may have is that its handling is complicated, the screw and nut joints with such small parts are hard for the child and, furthermore, when it comes to moving parts, these joints loosen easily.

The objective of this internship to design and manufacture of a prototype of a toy along the same lines as the "Meccano" but adapted to younger children, between 4 and 8 years old. For this, the pieces of the style of those shown in figures 1 must be made of plastic, with attractive colors, somewhat larger than those of the Meccano, but not too large, as we will see, with a joining system that can be made of screws. and nuts, but it is preferable to look for alternatives that are easier for the little ones.

The general characteristics of the toy will be designed. In addition, the prototype of a specific model consisting of around 100 pieces will be designed and manufactured. Their parts will be designed in a 3D computer-aided design application. The printing files for a fused-filament 3D printer will be generated with the 3D models. With these files, the pieces will be printed on the IKASIA Technologies machines. The graphic support will also be designed with the assembly instructions, which must be understandable by children, and the box that will contain the set will be designed as well. Therefore, the prototype must reach the final product.

The work will be carried out telematically by a group of 4 students supervised by a tutor from the company. The students must understand, from the first moment, that it is a work experience, carried out in telecommuting mode. This guide will specify, in addition to the objective and work plan, the organizational methods, personal and group work methods, computer tools to be used, the planning and control of the working day, the periodic report of results and everything related to the relationship between the worker and the company in the period of development of the internship.

2. Objective.

The objective of the work is to obtain a prototype of the construction game, applied to a model of a truck. The truck must have autonomous movement with a small electric motor. Once assembled, its approximate dimensions should be 300x150x150 mm. Most of the parts must be constructed of plastic. In the prototype these pieces will be produced by 3D printing,

although in a later commercialization they would be produced by injection molding. Metal shafts can be included, but the joints between the pieces must also be made of plastic and produced in a 3D printer.

3. Teleworking tools.

The design and prototyping work will be carried out using free access software. It is important that all the members of the group master the handling of the three essential tools that are going to be used at work. In this way, the design work of all the parts that make up the model can be distributed effectively, but it is also important because when learning the different tools that these programs contain, progress will be made much faster if each component of the group can help others by passing on what they have learned. Essentially the following software packages will be needed:

1.- *Computer assisted 3D design software*

It is the tool that will be used for the three-dimensional design of all the parts. Each part is defined in a file in STL format that collects the shape of its external surface. We will allow some time at the beginning of the development of the work plan for learning how to use this software, although most of the training will come during the actual making of the pieces.

2.- *Printer control software. Ultimaker Cura.*

This software prepares the 3D printer control GCODE file from the STL file that defines its shape. To do this, it converts the part to a layer-by-layer stack with the layer thickness the 3D printer will use. For each of the layers, the GCODE file will contain the point-to-point information of the movement that the print head must perform. This software must also be known by all members of the group. Its handling will be learned once the 3D design of the pieces to be built is advanced.

3.- *Computer assisted graphic design software.*

We will use these programs for the graphic design of the instruction manual that will accompany the model and also to make the model of the box that will contain the toy.

Besides these computer design and prototyping tools, telecommuting tools are required. A desktop or laptop computer is required to install the software packages we have described. It is also necessary to have access to a network with sufficient data transmission speed to hold a telematic meeting with image and sound.

We will also use free access software for telecommuting tools and software for the analysis and presentation of results are required.

4.- Software to hold telematic meetings: We will use Skype or Google Meet

Its use is very simple and probably all students know it beforehand.

5.- Office Software: Word processing, slide presentations: We will use Open Office.

It is likely that students are familiar with this software or other similar ones, especially regarding word processing, in any case, the different options and tools that they contain will be deepened throughout the internship.

6.- Documentation repository.

The company will make a network documentation storage space available to the group where all the activity and results of the project must be recorded. There will be a folder for the group and another one for each of the participants. In the latter, the individual work sheets will be saved, in addition to any results of the individually assigned tasks.

4. The working day.

This internship will be governed by teleworking regulations. Who participates in the internship will carry out a working day as another worker of the company, but the work will be carried out remotely. Telecommuting has advantages and disadvantages. Capitalize on the advantages requires following well-thought-out rules and strategies as well as a clear commitment on the part of the worker to their productivity on the one hand, and on the other, a commitment from the company in terms of adjusting the tasks assigned to the worker to the working day.

One of the advantages of teleworking is the flexibility of the working day. In this internship in a work environment, the working day will be 7.5 hours a day, of which a minimum of 2 hours will have a fixed schedule, the same for all participants in the internship. It will be from 9:00 to 11:00 and will be available for telematic group work meetings, meetings with the tutor or presentation of results. This schedule may be modified by the tutor throughout the internship depending on the progress of the work or the needs of the company. The rest of the working day may be set by each worker at their convenience. It is recommended that it be from Monday to Friday and the same every day of the week, although specific variations can be accepted. The worker will notify the tutor of his/her schedule and will be available during that period of time to respond to communications with the company or with the rest of the group members. The working time can be continuous or contains some short or long breaks. The beginning and end of the work will be registered daily by means of a message in the group chat on Skype. If it is a split day with a long interruption period, for example for lunch, the start and end of this interruption period will be recorded in the chat.

It is also recommended that the worker take short breaks at work, these short breaks increase the ability to concentrate at work and productivity. For example, one can rest 5 minutes after 25 minutes of work. These pauses do not need to be recorded in the chat.

IKASIA Technologies SL pays special attention to strict compliance with the working day, understood both in the productive fulfilment of the entire working day by the worker and in the complete disconnection from work outside of the working day. This requirement is especially important in telecommuting in which there is not such a clear difference between the work environment and the personal environment of the worker. Efforts will be made to ensure that the assigned work plan is perfectly defined and that it is realistic and consistent with the working day. It is essential to maintain the effective activity during the working day to fulfil the planned tasks, it is not acceptable to prolong the working day because it has not been sufficiently effective in the time set. In any case, it must be accepted that it may happen that the estimate of the time required for the tasks scheduled for a specific day or days could be unrealistic. In that case the work plan should be readjusted. These aspects should be openly discussed within the group and with the tutor.

5. Activity log sheets.

When working remotely, the worker finds himself in an environment in which interaction with other company workers is limited both in time and because it is telematic.

In this way of working, it is absolutely advisable to establish an individual work plan for each day at the beginning of the day and end it with a review of the activities carried out. Attached below is a model sheet that may be useful in this regard, in which we include some examples of such activities. No more than 10 minutes should be spent at the beginning and end of the day to fill in these forms.

Date	Worker	
Planned activities	**Target. Result to be achieved.**	**End of day comment.**
Group meeting.	Today we have to talk about...	The meeting was held but I don't think we have reached clear conclusions. We need to continue talking about this point.
Decision on the anchoring of the motor and the electronic circuits.	3D construction draft plans.	The files have been uploaded to the group folder with filenames: xxxxxxxxx, yyyyyyyyyy.
Meeting with colleague xxxxxx so that he can explain to me how the curved surfaces of the casing are built in the 3D design program.	I think he knows how to do it and it will save me work if he explains it to me.	The meeting was held and I think I have a clear idea about how to do it. or We haven't had much time to talk, I didn't fully understand it, we'll continue tomorrow.

These files must be uploaded daily to the individual folder of the worker in the shared space.

6. Group meetings.

The objective set forth in this internship brings together a series of aspects that makes that it has to be addressed by a relatively large group of workers. On the one hand, it requires a high volume of work, probably beyond the scope of a single person in the duration of the internship. On the other hand, it is necessary to learn the handling of computer techniques and tools independently. There is not going to be a teacher who explains every detail and who to consult every doubt. Under these conditions, group work can multiply the results, what one person does not know how to do, maybe someone else knows how to do it, and the one who understands the fastest an aspect of what is being studied can explain it to others and save them time. Explaining something is the best way to understanding it deeply and assimilating it.

It will be necessary to reach agreements on the design of the product that is intended to be obtained. The fact that there are different opinions is very positive. Criticism of the proposals that arise is essential to avoid mistakes and arrive at the best possible solutions.

The distribution of tasks should also be agreed in group meetings. In this internship, the tutor is not going to assign the tasks to each component of the group, although he/she can help in case of conflict. The tutor will not judge in detail the fulfilment of the tasks by each one either. One of the most difficult aspects, but one that must be learned, is to raise the issue of the non-compliance of some component of the group and do it in a way that encourages solving the problem rather than delving into conflicts. Also in this sense, the tutor can be of help at some point, but it is the group that must adjust its modes of operation and generate dynamics that are motivating.

For all this, the group meetings are important and the fact that they are dynamic and effective meetings is one of the keys to the success of the project. Meetings can address issues like:

- Brainstorming about the design of the toy: dimensions, types of parts, sizes, moving parts...

- Distribution of tasks: looking for information on existing toys on the market, design of specific parts, search for solutions to problems encountered in handling the software, Internet queries...

- Report on the tasks carried out: communicate effectively to the group the results of the tasks carried out.

- Study sessions in which each member of the group exposes certain theoretical or practical aspects necessary for the development of the project, for example, design tools or 3D printing, properties of printing materials, motion transmission elements ...

- Evaluation of project progress.

- Drafting the presentations of results to the tutor or to the team of the company as a whole.

Some indications given so the group meeting is effective:

- A maximum period of time for the meeting should be determined, which will depend on its objectives. There may be very short meetings, perhaps only half an hour for specific issues, and long ones of up to two hours dedicated to study sessions.

- The frequency of the meetings will depend on how productive they are. Nevertheless, in the case of teleworking, each worker only has contact with the others through telematic meetings. One should reserve a daily space to establish these contacts. From that point of view, it would be convenient to set the meeting at the same time every day, even though some days there isn't much to discuss, and it ends right away.

- Besides group meetings, meetings between two colleagues for specific doubts should not be skimped on. It is convenient to keep the teleconference channel open and be able to make a call at any time during the working day.

- The meeting agenda must be set in advance, at the end of each meeting the agenda of the next one can be set. In any case, at the beginning of the meeting, the first item on the agenda may be to review the agenda and decide whether to add or remove one.

- The meeting must have leader to organize the discussion. They must be chosen at the beginning of the meeting or rotated among the different components of the group. It is the function of the chair to ensure that all the points are discussed, and conclusions are reached within the period of time set for the meeting.

- The meeting must have a leader. It must also be a position that rotates among all the members of the group. He/she must write down the most relevant aspects of the discussion, the conclusions, and the agreements reached. All this must be collected in the form of minutes that will be uploaded to the shared space in the group folder. The minutes of each meeting will be approved at the next meeting.

7. Meetings with the tutor.

The internship tutor is a company worker, with his own tasks and responsibilities. The time they can spend tutoring the group's work is limited. That is why it is necessary to prepare well for meetings with them. In principle, ordinary meetings will be weekly, although extraordinary meetings may be convened at any time at the initiative of the tutor or the group. The meetings will consist of a presentation of the progress of the work by one of the members of the group. The activities carried out, the decisions made, and examples of the results achieved will be explained. A slide presentation will be used for this. The duration of the presentation will be a maximum of 30 minutes and will be followed by a discussion in which the tutor will pose doubts or suggestions and the members of the group can also raise their doubts. The adequacy of the progress of the project to the planned schedule will be discussed and, if necessary, the group can propose the readjustment of the work plan.

8. Work plan.

In the work plan presented below, an attempt has been made to identify in detail all the tasks that need to be carried out to achieve the project objective. We list them consecutively, with a brief description, the execution time period and the tangible results that must be obtained from them. In any case, the breakdown of tasks may not be complete and during the development of the project new ones can be detected or some of the specified ones can be seen as unnecessary. The group can make the necessary readjustments. There are tasks that must be carried out by all the members of the group, others for which only one of the components can be responsible.

The internship is organized in three phases or work packages.

Phase 1. Understanding the problem. Training in teleworking tools. Preliminary solution.

Task 1.1. Understanding the problem.

Group meeting with the tutor. Problem Statement. Objective of the project. Review of work organization strategies: group meetings, working hours, distribution of tasks, regular presentation of project progress... Computer tools.

Result to obtain: The four components of the group must have a clear idea of the characteristics required to the product to be obtained.

Dates: Day 1.

Task 1.2. Installation of software on individual computers.

Each member of the team can be responsible for finding a tutorial or written instructions on the Internet for the installation and configuration of one of the necessary software packages and passing that information to the others. Each will install the tools on their computer. Communication between all the members of the group is important to resolve the doubts that one or the other may have.

Result to obtain: All the components of the group must have all the necessary software installed on their computers and configured.

Dates: Week 1.

Task 1.3. State of the art. Available construction sets similar to "Meccano".

Search for information on the construction toys that are currently or have been on the market. Pay special attention to the methods of joining the pieces, the moving elements, the dimensions, the materials used...

Result to obtain: A presentation with slides that gathers the results of the search, with a brief description of the main characteristics of the construction set. You should prepare it to present it to your tutor in approximately 10 minutes. The documents with the downloaded information will be uploaded to the shared space in a specific folder within the group folder.

Dates: Week 1.

Task 1.4. State of the art. Available truck model toys with characteristics similar to the specified ones.

It is about having references of existing toy trucks that serve as a design aid. Pay attention to the accessories they contain (cranes, dump trucks...) and the movement mechanisms (wheels, motor, drive of the moving parts...). Information should also be sought on electric motors available on the market that can be adapted to the toy.

Result to obtain: A presentation with slides that gathers the results of the search, with a brief description of the main characteristics of the construction set. You should prepare it to present it to your tutor in approximately 10 minutes. The documents with the downloaded information will be uploaded to the shared space in a specific folder within the group folder.

Dates: Week 1.

Task 1.5. State of the art. Fused filament 3D printers.

Internet search of the different materials available as printing filament, their mechanical characteristics, available colors… Printing parameters, resolution, layer height…. What is a GCODE file for printer control?

Result to obtain: A presentation with slides that collects the results of the search. You should prepare to present it to the tutor in approximately 10 minutes. The documents with the downloaded information will be uploaded to the shared space in a specific folder within the group folder.

Dates: Week 1.

Task 1.6. State of the art. Toy graphic design.

Internet search for examples of toy packaging similar to the one to be designed, graphic design of the packaging and assembly instructions. How do they prepare instructions for children from 4 to 8 years of age?

Result to obtain: A presentation with slides that collects the results of the search. You should prepare to present it to your group mates in approximately 10 minutes. The documents with the downloaded information will be uploaded to the shared space in a specific folder within the group folder.

Dates: Week 1.

Task 1.7. Preliminary design.

At the beginning of the second week of work, the group should be able to spend one or several long group meetings to present and discuss the results of tasks 1.3, 1.4 and 1.5 and to think about the preliminary design of the device. Decisions must be made about the design of the ensemble and about certain details of its construction:

- Material from which the parts in the prototype will be built.

- Thickness of flat pieces: rods, plates of different shapes…

- Diameter and separation between the perforations.

- Topography of the surface of these pieces (they do not have to be flat, they can have some surface topography if considered convenient)

- Joining method: screws, nuts, clips, rubbers (size, printing material with which they must be made, which does not have to be the same as that of the parts)

- Design of the wheels. Union to the shafts.

- Design of the transmission elements: gear wheels, belts, pinions, joints to the shafts.

- Flexible parts: printing materials.

All these decisions have to be based on an in-depth analysis of the state of the art, that is, of what has already been done. The idea is to innovate, but not from scratch but from what is already known. Throughout the work, these initial ideas will probably be modified, but they are a very important work basis for the success of the project.

Result to obtain: Idea of the preliminary design of the ensemble, reflected in the form of diagrams and freehand drawings. Sizes and shapes of the main parts. Decision on the design of the joining elements. Materials selection.

Dates: Weeks 2 and 3.

Phase 2. Project execution. Design and construction of the prototype.

Task 2.1 Training in the use of the 3D design program.

This task will begin with an initial lecture given by the tutor of the work, as a form of an introduction to the use of the program. It will be in a theoretical-practical session of about two hours in which the members of the group will do the exercises that the tutor will propose on their computers.

From there, the ability in the use of the program will be deepened while the design of the different pieces that will make up the device is developed. Doing group work will be

essential here to resolve any doubts that may arise. What one learns will serve the other. Each one may be designing different pieces, but the design tools are the same for everyone.

Result to obtain: Fluency in handling the 3D design program to generate the STL files of all the pieces.

Dates: Weeks 2, 3 and 4.

Task 2.2 Design of each of the pieces that make up the set. First approximation.

The three-dimensional representation of each of the pieces will be built separately. The pieces will be distributed among the components of the group. Each of them will give rise to a file in the format of the 3D design application, a file in STL format, a representation in image format, to be included in a slide show, and a representation in a dihedral system.

The progress in the work will be analyzed in the group meetings. Each of its components will present their designs to the rest and they will be analyzed looking for errors or discrepancies between what one or the other is doing.

Result to obtain: They will be of the order of 100 pieces designed, reviewed and approved by the group.

Dates: Weeks 2 to 6.

Task 2.3 Model overview

The 3D design software allows you to assemble the pieces to build an overall image, starting from the individual files of each part. This is a group task both learning to do it and carrying out the task. The strategy for this will be decided by the group and will be adjusted according to the progress of the work. The tutor can help by giving a first initiation talk to this process or giving instructions at important moments or resolving doubts. It is about "playing" virtually. The construction of the overview can follow the steps of the construction of the truck and serve to generate image files that are used to prepare the instruction manual.

Result to obtain: 3D files of the assembly of the device. Demonstration that all the pieces fit together correctly before going on to produce the prototypes.

Dates: Week 6 and 7.

Task 2.4 Generation of printing files.

Training in the use of the CURA program to generate the GCODE files for each of the pieces. Once the GCODE files are prepared, they will be thoroughly reviewed in group meetings. These files are going to be printed on IKASIA Technologies SL machines, using production time and dedication time of its staff. It is very important to be as sure as possible that there are no errors in the files that lead to having to repeat the work.

A document will be prepared, in spreadsheet format, slide presentation or text document, in which each piece to be printed is shown as it should be after printing (image taken from CURA), the printing material, and the main print data. These data are collected in the GCODE file but it is about making it easier for the 3D printing machine operator to see quickly what is going to be printed and the decisions that have been made regarding the printing parameters, so that with his experience, he can detect an eventual error before start printing.

Result to obtain: GCODE files that allow the printing of all the parts.

Dates: Week 6 to 8.

Task 2.5 Acquisition of commercial parts.

Some elements will not be produced by 3D printing, but purchased from commercial companies, for example, the motor, shafts, transmission elements, gear wheels, bearings, etc. Orders will be placed in accordance with the tutor.

Result to obtain: Reception of the parts at the IKASIA Technologies facilities.

Dates: Weeks 6 and 7.

Task 2.6 Checking.

It would be highly desirable if one of the members of the group could travel to the IKASIA Technologies facilities in Valencia for one or several days to physically assemble the toy and detect any errors that may have occurred in the design and/or manufacture of the parts. This activity will be carried out in telematic connection with the rest of the group to discuss in depth the result obtained. If it were not possible for a member of the group to carry out this activity at IKASIA Technologies, it would be a member of the company's team or the tutor himself who would do it. If there are errors, the necessary pieces will be repeated together with the additional pieces determined in task 2.7.

Result to obtain: Complete check and approval of the result by the group and the tutor.

Dates: Week 9.

Task 2.7 To play. Additional pieces.

This prototype, we must not forget it, is a construction toy. Instructions for assembling a model are given, but the toy is expected to develop the child's imagination and enable them to build many other model toys. This activity is about playing at making other designs with the built pieces. It can be with the physical prototype or with the 3D design application. When you start playing with it, it is more than possible that you realize that for what you want to do, you would need an additional piece, or a specific piece, or a greater number of pieces already designed. It is worth discussing it in a group and adding those pieces, that is, making the corresponding designs and files and printing them. Any part of the originals that contains errors will also be repeated.

Result to obtain: Final set of pieces.

Dates: Weeks 9 to 12.

Task 2.8 Training in the use of the graphic design program.

As in the other software packages, the tutor or another person from the IKASIA Technologies team will introduce the group to the handling of the graphic design software.

The graphic design will be deepened by preparing the assembly instructions manual for the truck. It is important to keep in mind that it is aimed at children from 4 to 8 years of age. The little ones don't know how to read.

Result to obtain: Assembly instructions manual.

Dates: Weeks 8 and 9.

Task 2.9 Design of the box that will contain the toy.

Again, the design must be based on an in-depth analysis of the state of what already exists in the market. The conventional model may be a rectangular box that has holes with the shape of the pieces in which they are inserted. But, of course, there may be innovative solutions: bags, plastic or cardboard buckets… Depending on the shape of the wrapper, its graphic design will be made. Oh, and the name of the toy.

Result to obtain: Box design.

Dates: Weeks 8 to 12.

Phase 3. Conclusions. Final Presentation.

Task 3.1 Final Presentation.

At the end it is necessary to draft a written document that describes not only the final result but also the whole work carried out. It should have:

- A summary showing the final result, highlighting its main features.

- The most relevant decisions made regarding the design of the device, clearly justifying why those have been adopted and the alternatives that have been discarded.

- The overall image of the toy, inside the box, the assembled truck, etc.

- The instruction manual.

- The location of the files of each part and of the set, in all the formats made, clearly specifying the name of each file and the folder that contains it in the shared space.

- A discussion of the result obtained, highlighting the strengths and weaknesses of the design, the points where further progress could be made, or those problems that have remained unresolved.

There will be a team presentation, lasting approximately 30 minutes. It will be a telematic presentation open to the staff of the companies and educational centers involved in the project *VIRTUAL INTERNSHIPS IN TECH CENTERS: training VET students with obstacles into an innovative digital methods of remote working and e-Learning created from COVID-19.*

A short video version of this presentation will be prepared for publication as part of the project's outreach program. In any publication related to this work, the students who have participated in it and their tutor and those responsible for the work in the company will appear as co-authors, as well as the person who has designed their objective and work plan.

Result to obtain: Final written report and oral presentation.

Dates: Weeks 10 to 12.

9. **Deliverables.**

This section lists the set of documents and other tangible results that must be delivered to the company throughout the development of the project.

E1.- Individual work sheets. Daily. Delivered in the individual folder of each component of the group in a subfolder with this name.

E2.- Minutes of group meetings and meetings with the tutor. Once approved by the group at the next meeting. The slide presentations used in the meeting will be attached. Delivered in the group folder in a subfolder with this name.

E3.- Files of each of the pieces. 3D design application format, STL format, image format, image format in dihedral system, GCODE printing file. Delivered in the group folder in a subfolder with this name.

E4.- **Files of the overview.** 3D design application format, image format. Delivered in the group folder in a subfolder with this name.

E5. **Manual to build the model**. File in editable format containing text and relevant figures.

E6. **Final report of the project.** Word processing format.

E7. **Prototype.** Delivered to the tutor at the facilities of IKASIA Technologies in Valencia.
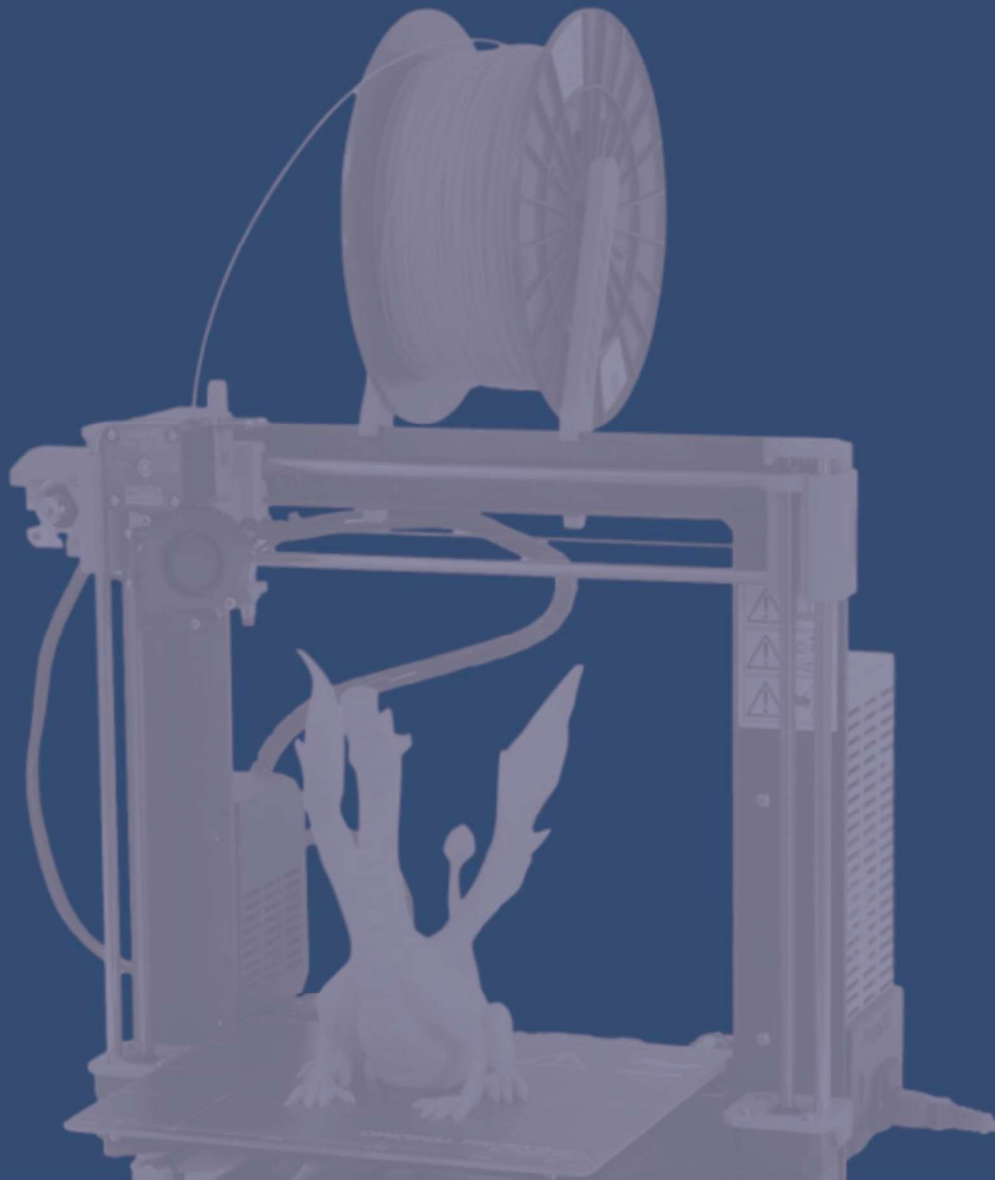
10. Schedule.

Task		Deliverable															
Phase 1																	
1.1	Understanding the problem.			▓													
1.2	Installation of software.			▓													
1.3	Information: Constructions sets similar to Meccano.			▓													
1.4	Information truck toys.			▓													
1.5	Fused filament 3D printers.			▓													
1.6	Information: graphic design.			▓													
1.7	Preliminary design				▓	▓											
Phase 2																	
2.1	Training in the use of the 3D design software.				▓	▓	▓										
2.2	Design of the pieces.				▓	▓		▓	▓								

2.3	*Device overview.*									▓	▓						
2.4	*Generation of printing files.*										▓						
2.5	*Acquisition of commercial parts.*									▓	▓						
2.6	*Checking.*											▓					
2.7	*To play. Additional pieces.*											▓	▓	▓	▓		
2.8	*Training in graphic design*											▓	▓				
2.9	*Box design.*											▓		▓	▓		
Phase 3																	
3.1	*Final presentation.*												▓	▓	▓		

critical
**Virtual Internships
in Tech Centers**
thinking

INTERNSHIP MODEL FOR THE DESIGN AND CONSTRUCTION OF 3D PRINTING MACHINERY

IKASIA
TECHNOLOGIES

METHODOLOGICAL GUIDE: THE VIRTUAL INTERNSHIPS IN TECH CENTERS

1. Introduction and purpose of the internship.

There are many applications where continuous and reproducible agitation of tubes containing solutions or suspensions is required to keep them homogeneous. There are many commercial devices such as those shown in the images in Figure 1.

Figure 1. Some examples of images of commercial shakers for tubes.

The functioning of these systems is actually quite simple. They consist of a platform on which the tubes are fixed, each closed with its own cap. This platform can rotate around an axis that is horizontal in some cases and vertical in others. There are shakers that rotate the tubes completely around the platform, while other designs allow them to rotate through an angle, in a tilting fashion, that can be programmed, and even allow the tubes to be subjected to additional vibration at certain points in their travel.

These devices are often found in hospitals, for example, in hematology departments for testing blood components. They are also seen in chemical laboratories because many reactions take place under agitation, they are used to maintain homogeneity in the mixture of reagents. In cell culture laboratories they are used to grow cells in suspension in a liquid culture medium. They are also common in materials synthesis and characterization laboratories, for example, in solvent extraction systems or the homogenization of paints and suspensions.

The requirements are not very demanding, but they must be robust because they are going to work continuously for hours or days. Depending on the application they will need to be located in environments at temperatures somewhat above or somewhat below room temperature, for example 37°C in cell culture or 4°C in many chemical reactions involving proteins.

2. Objective.

The objective of the work is the design and construction of an Eppendorf tubes shaker for cell cultures. It must be produced mostly by additive manufacturing and its drive will be done with an Arduino-controlled stepper motor. The programming of the movement must be done on a tablet or laptop and transfer the motor control program to the device via Bluetooth or with a USB stick. It will allow equal agitation of at least 30 tubes simultaneously. As a novel feature, the shaker is intended to allow tubes to be placed without a cap and a single cap closes all tubes at once. This will save a lot of operating time in the specific application for which it is intended.

3. Working methods.

3.1. Computer tools

The design and prototyping work will be carried out using free access software. It is important that all the members of the group master the handling of the three essential tools that are going to be used at work. In this way, the design work of all the parts that make up the model can be distributed effectively, but it is also important because when learning the different tools that these programs contain, progress will be made much faster if each component of the group can help others by passing on what they have learned. Essentially the following software packages will be needed:

1.- *Computer assisted 3D design software*

It is the tool that will be used for the three-dimensional design of all the parts. Each part is defined in a file in STL format that collects the shape of its external surface. We will allow some time at the beginning of the development of the work plan for learning how to use this software, although most of the training will come during the actual making of the pieces.

2.- *Printer control software. Ultimaker Cure.*

This software prepares the 3D printer control GCODE file from the STL file that defines its shape. To do this, it convert the part to a layer-by-layer stack with the layer thickness the 3D printer will use. For each of the layers, the GCODE file will contain the point-to-point

information of the movement that the print head must perform. This software must also be known by all members of the group. Its handling will be learned once the 3D design of the pieces to be built is advanced.

3.- Arduino control software.

The operation and control of the Arduino will be studied in internet tutorials

Besides these computer design and prototyping tools, tools for the analysis and presentation of results are required.

4.- Office Software: Word processing, slide presentations: We will use Open Office.

It is likely that students are familiar with this software or other similar ones, especially in the case of word processing, in any case, the different options and tools that they contain will be deepened throughout the internship.

5.- Documentation repository.

The company will make a network documentation storage space available to the group where all the activity and results of the project must be recorded. There will be a folder for the group and another one for each of the participants. In the latter, the individual work sheets will be saved, in addition to any results of the individually assigned tasks.

3.2 Activity log sheets.

The design and construction of the device requires carrying out a set of tasks that are very different from each other: search for information, learn the use of different computer packages, thoroughly understand the operation and control of stepper motors, make oral and written presentations… Some of these tasks will be shared between the two members of the group and others will be carried out by both. In this way of working, it is absolutely advisable to establish an individual work plan for each day at the beginning of the day and end it with a review of the activities carried out. Attached below is a model sheet that may be useful in this regard, in which we include an example of an activity. No more than 10 minutes should be spent at the beginning and end of the day to fill in these forms.

Date	Worker	
Planned activities	**Target. Result to be achieved.**	**End of day comment.**
Group meeting	Today we have to talk about...	The meeting was held but I don't think we have reached clear conclusions. It will be necessary to continue talking about this point.
Decision on the anchoring of the motor and the electronic circuits	3D construction draft plans	The files have been uploaded to the group folder with filenames: xxxxxxxxx, yyyyyyyyyy
Meeting with colleague xxxxxx so that he can explain to me how the curved surfaces of the casing are built in the 3D design program	I think he knows how to do it and it will save me work if he explains it to me	The meeting is done and I think I have a clear idea about how to do it. or We haven't had much time to talk, it hasn't been clear to me, we'll continue tomorrow.

These files must be uploaded daily to the individual folder of the worker in the shared space.

4. Work plan.

In the work plan presented below, an attempt has been made to identify in detail all the tasks that need to be carried out to achieve the project objective. We list them consecutively, with a brief description, the execution time period and the tangible results that must be

obtained from them. In any case, the breakdown of tasks may not be complete and during the development of the project new ones are detected or some of the specified ones are seen as unnecessary. The group can make the necessary readjustments. There are tasks that must be carried out by all the members of the group, others for which only one of the components can be responsible.

The internship is organized in three phases or work packages.

Phase 1. Understanding the problem. Preliminary solution.

Task 1.1. Understanding the problem.

Group meeting with the tutor. Problem Statement. Objective of the project. Review of work organization strategies: group meetings, working hours, distribution of tasks, regular presentation of project progress... Computer tools.

Result to obtain: The two components of the group must have a clear idea of the characteristics required of the product to be obtained.

Dates: Day 1.

Task 1.2. Installation of software on individual computers.

Each member of the team can be responsible for finding a tutorial or written instructions on the Internet for the installation and configuration of one of the necessary software packages and passing that information to the others. Each will install the tools on their computer. Communication between all the members of the group is important to resolve the doubts that one or the other may have.

Result to obtain: all the components of the group must have all the necessary software installed on their computers and configured.

Dates: Week 1.

Task 1.3. State of the art. Tube agitators available on the market.

Search for information on the agitators that are currently or have been on the market. Pay special attention to the solutions that have been adopted to fix the tubes, the movement to which they are subjected and the programming, the dimensions, the materials used, the aesthetics of the casing...

Result to obtain: A presentation with slides that gathers the results of the search, with a brief description of its main characteristics. You should prepare it to present it to your tutor in approximately 10 minutes. The documents with the downloaded information will be uploaded to the shared space in a specific folder within the group folder.

Dates: Week 1

Task 1.4. State of the art. Scheme of solutions adopted in commercial devices.

It is about building a scheme of ideas that includes the options found for each of the elements of the device on whose design a decision must be made. They have been mentioned in the previous task.

Result to obtain: A presentation with slides that collects the results of the search. You must prepare to present it to the tutor in approximately 10 minutes. The documents with the downloaded information will be uploaded to the shared space in a specific folder within the group folder.

Dates: Week 1

Task 1.5. State of the art. Fused filament 3D printers.

Internet search of the different materials available as printing filament, their mechanical characteristics, available colors... Printing parameters, resolution, layer height.... What is a GCODE file for printer control?

Result to obtain: A presentation with the results of the search. You should prepare to present it to the tutor in approximately 10 minutes. The documents with the downloaded information will be uploaded to the shared space in a specific folder within the group folder.

Dates: Week 1.

Task 1.6. State of the art. Stepper motors. Control via Arduino.

Download a tutorial on the operation and connection of the motorization components. Decisions will have to be made about the motor model, the power it can develop, the shaft rotation speed range. You can look up examples of using these engines in other types of devices to get a rough idea of what to expect from them.

Thoroughly understand the operation of the motor, how an Arduino controls that movement, how to edit a file that defines all the movements in a complete cycle of operation of the device, for example, the back and forth movement at a certain speed for three days. Understand how the edited file is uploaded to the Arduino on a computer via USB or Bluetooth and start the operation. Look for possible suppliers of both the motor and the Arduino, models, prices, delivery times…

Result to obtain: a brief presentation of about 10 minutes, with the motors available on the market, their dimensions, power, turning speeds, etc.

Dates: Weeks 1 and 2.

Result to obtain: Demonstration circuit in which the motor, simply placed on the table, receives the instructions to make 60º turns to the right and left in a back and forth movement. The documents with the downloaded information will be uploaded to the shared space in a specific folder within the group folder.

Dates: Weeks 1 to 4.

Task 1.7. Preliminary design

At the beginning of the second week of work, you should be able to spend one or several long group meetings to present and discuss the results of tasks 1.3, 1.4 and 1.5 and to think about the preliminary design of the device. Decisions must be made about the design of the ensemble and about certain details of its construction:

- Platform where the tubes containing the suspension to be shaken will be held. The goal is to make it as easy as possible to put the tubes in place and then remove them. It is interesting that it be not necessary to cover them one by one, but that a single lid closes them all at the same time.

- Parts that anchor the platform to the motor shaft in such a way that allow a movement that can be defined in a very versatile way.

- Case. Engine housing and mounting. Accommodation of electronic circuits.

- Material from which the parts in the prototype will be built.

- Unions between the different pieces that make up the device.

- Movement programs: full turns, swing, vibration.

All these decisions have to be based on an in-depth analysis of the state of the art, that is, of what has already been done. The idea is to innovate, but not from scratch but from what is already known. Throughout the work, these initial ideas will probably be modified, but they are a very important work basis for the success of the project.

Result to obtain: Idea of the preliminary design of the complex, reflected in the form of diagrams and freehand drawings. Sizes and shapes of the main parts. Decision on the design of the joining elements. Materials selection.

Dates: Weeks 2 and 3.

Phase 2. Project execution. Design and construction of the prototype.

Task 2.1 Training in the use of the 3D design program.

This task will begin with an initial class given by the tutor of the work, as a form of initiation to the use of the program. It will be in a theoretical-practical session of about two hours in which the members of the group will do the exercises that the tutor will propose on their computers.

From there, the management of the program will be deepened while the design of the different pieces that will make up the device is developed. Doing group work will be essential here to resolve any doubts that may arise. What one learns will serve the other. Each one may be designing different pieces, but the design tools are the same for everyone.

Result to obtain: Fluency in handling the 3D design program to generate the STL files of all the pieces

Dates: Weeks 2, 3 and 4

Task 2.2 Design of each of the pieces that make up the set. First approximation.

The three-dimensional representation of each of the pieces will be built separately. The pieces will be distributed among the components of the group. Each of them will give rise to a file in the format of the 3D design application, a file in STL format, a representation in image format, to be included in a slide show, and a representation in a dihedral system.

Result to obtain: Set of pieces designed, reviewed and approved by the group and the tutor.

Dates: Weeks 3 to 6.

Task 2.3 Device overview

The 3D design software allows you to assemble the pieces, of which you have the individual files, to build an overall image. This is a group task both learning to do it and carrying out the task. The tutor can help by giving a first initiation class to this process or giving instructions at important moments or resolving doubts.

Result to obtain: 3D files of the assembly of the device. Demonstration that all the pieces fit together correctly before going on to produce the prototypes.

Dates: Week 6 and 7.

Task 2.4 Generation of the printing files.

Training in the use of the CURA program to generate the GCODE files for each of the pieces. Once the GCODE files are prepared, they will be thoroughly reviewed in group meetings. These files are going to be printed on IKASIA Technologies SL machines, using production time and dedication time of its staff. It is very important to be as sure as possible that there are no errors in the files that lead to having to repeat the work.

A document will be prepared, in spreadsheet format, slide presentation or text document, in which each piece to be printed is shown as it should be after printing (image taken from CURA), the printing material, and the main print data. These data are collected in the GCODE file but it is about making it easier for the 3D printing machine operator to see quickly what is going to be printed and the decisions that have been made regarding the printing parameters, so that with his experience, he can detect an eventual error before start printing.

Result to obtain: GCODE files that allow the printing of all the parts.

Dates: Week 6 to 8.

Task 2.5 Acquisition of commercial parts.

In addition to the motor and its control circuits, some elements will not be produced by 3D printing but will be purchased from commercial companies, for example, shafts, transmission elements, metal parts in joints, bearings, etc… Orders will be placed in accordance with The tutor.

Result to obtain: Reception of the parts at the IKASIA Technologies facilities.

Dates: Weeks 6 and 7.

Task 2.6 Motor control programs.

Develop simple instructions to generate a text file that Arduino can read and execute.

Dates: Weeks 6 to 8.

Task 2.7 Manufacture of parts by 3D printing. Assembly.

The precision of the parts and their assembly will be checked as they are produced. At the end of week 9, all the prototype parts should be available and any errors that may have occurred in the design and/or manufacture of the parts should be detected. If there are errors, the pieces will be repeated as necessary.

Result to obtain: Complete check and approval of the result by the group and the tutor.

Dates: Weeks 8 and 9.

Task 2.8 Fine tuning. Calibration. Testing performance.

The calibration must verify the angles of rotation, movement speeds, measurement of the rest time if any, etc. On the other hand, it is necessary to verify that in continuous movement unacceptable wear is not produced in any of the pieces produced by additive manufacturing. Usually weak points are bearing housings, screwed parts or parts subjected to friction. It may be necessary to correct the design of some of them. Any part of the originals that contains errors will also be repeated.

Result to obtain: Final set of pieces.

Dates: Weeks 9 to 12.

Task 2.9 Drafting of the instructions for use manual.

Dates: Week 11.

Phase 3. Conclusions. Final Presentation.

Task 3.1 Final Presentation.

At the end it is necessary to prepare a written document that describes not only the final result but also the whole of the work carried out. It should contain:

- The most relevant decisions made regarding the design of the device, clearly justifying why those have been adopted and the alternatives that have been discarded.

- The overall image of the device.

- The instruction manual.

- The location of the files of each part and of the set, in all the formats made, clearly specifying the name of each file and the folder that contains it in the shared space.

- A discussion of the result obtained, highlighting the strengths and weaknesses of the design, the points where further progress could be made, or those problems that have remained unresolved.

There will be a team presentation of approximately 30 minutes. It will telematic, open to the staff of the companies and educational centers involved in the project *VET STUDENTS İNTO TECHNOLOGY COMPANİES: A VET students mobility network in the technological sector through a virtual environment with specific materials for critical thinking.*

A short video version of this presentation will be prepared for publication as part of the project's outreach program. In any publication related to this work, the students who have participated in it and their tutor and those responsible for the work in the company will appear as co-authors, as well as the person who has designed their objective and work plan.

Result to obtain: Final written report and oral presentation.

Dates: Weeks 10 to 12.

5. Deliverables.

In this section we list the set of documents and other tangible results that must be delivered to the company throughout the development of the project.

E1.- Individual work sheets. Daily. Delivered in the individual folder of each component of the group in a subfolder with this name.

E2.- Minutes of group meetings and meetings with the tutor. Once approved by the group at the next meeting. The slide presentations used in the meeting will be attached. Delivered in the group folder in a subfolder with this name.

E3.- Files of each of the pieces.3D design application format, STL format, image format, image format in dihedral system, GCODE printing file. Delivered in the group folder in a subfolder with this name.

E4.- Files of the overview. 3D design application format, image format. Delivered in the group folder in a subfolder with this name.

E5. Manual. File in editable format containing text and relevant figures.

E6. Final report of the project. Word processing format.

E7. Device prototype. Delivered to the tutor at the facilities of IKASIA Technologies in Valencia.
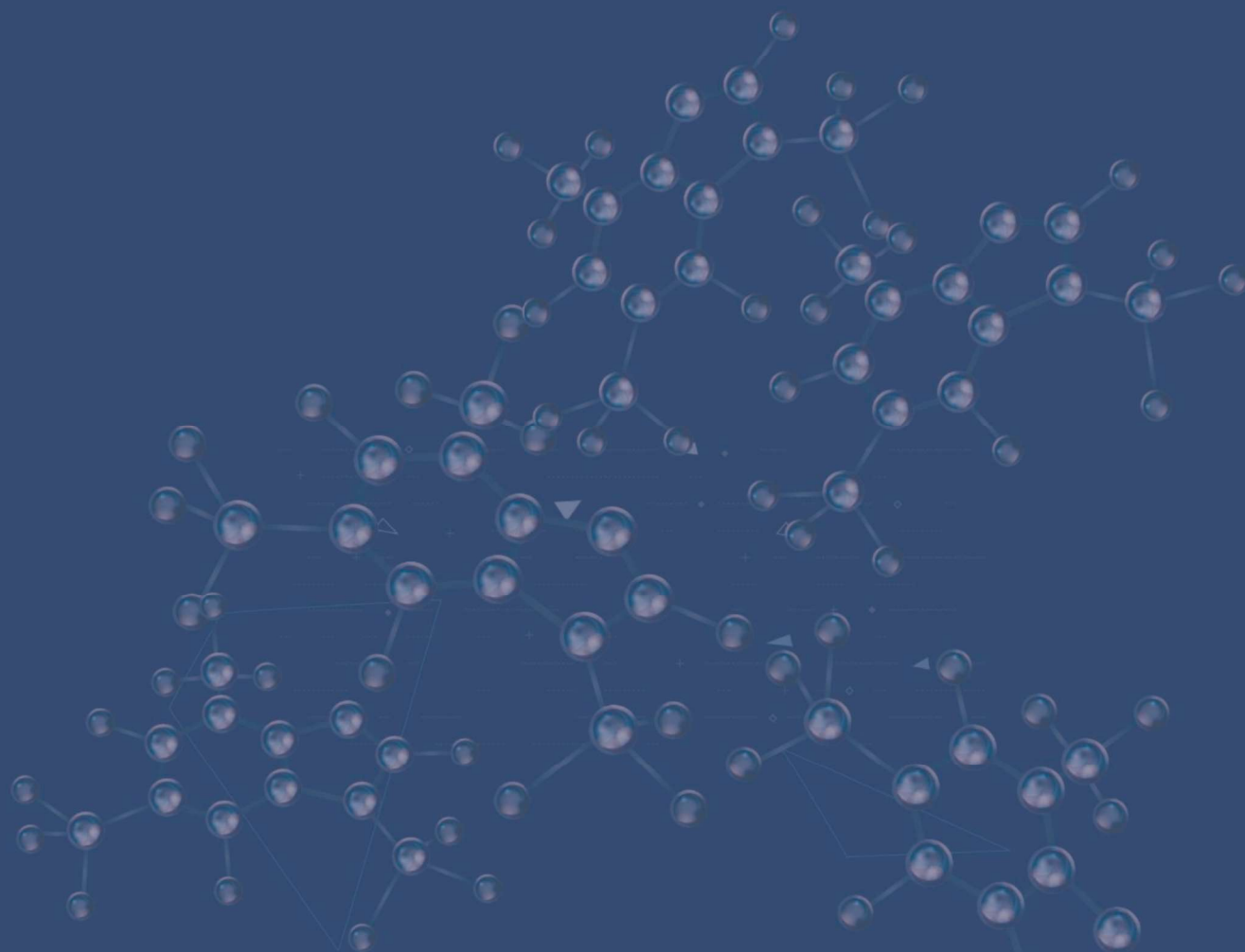
6. Timeline.

Task		Deliverable														
Phase 1																
1.1	Understanding the problem.															
1.2	Installation of software.															

		Timeline
1.3	*Tube agitators available on the market.*	▓ (early)
1.4	*Scheme of solutions adopted in commercial device.*	▓ (early)
1.5	*Fused filament 3D printers.*	▓ (early)
1.6	*Stepper motors. Control via Arduino.*	▓ (early)
1.7	*Preliminary design.*	▓
Phase 2		
2.1	*Training in the 3D-design software.*	▓
2.2	*Design of each of the pieces*	▓
2.3	*Device overview.*	▓
2.4	*Generation of printing files.*	▓
2.5	*Acquisition of commercial parts.*	▓
2.6	*Motor control programs.*	▓
2.7	*Manufacture of parts by 3D printing. Assembly.*	▓
2.8	*Fine tunning*	▓
2.9	Drafting of the instructions for use manual.	▓
Phase 3		
3.1	*Final Presentation.*	▓ (late)

INTERNSHIP MODEL FOR LABORATORY TECHNICIAN

IKASIA
TECHNOLOGIES

METHODOLOGICAL GUIDE: THE VIRTUAL INTERNSHIPS IN TECH CENTERS

1. Introduction and purpose of the internship.

As one can imagine, it is not easy to propose a virtual internship for laboratory technician, just as it is not easy to propose teleworking in the position of laboratory technician. When one thinks of the position of traditional laboratory technician, in charge of the maintenance of the devices, their calibration, of the attention to the users teaching them the device that they are going to handle etc., but there are many different tasks of the laboratory technician that focus more on the analysis of results, and these tasks, depending on the job position, can occupy a very important part of the working day and, in general, of the activity of the technician. On the other hand, it is very important for a technology company to have experienced professionals in data treatment of a team, in tasks related to the download of data in manageable files for its treatment and that knows, even at a basic level, the techniques of statistical analysis of that data. That experience and knowledge are important to assist in the design of experiments and to take advantage of the results obtained.

In this internship we will work on the treatment and analysis of images for different applications. A first example: a production of alginate microspheres that have been produced with a microfluidic system (we will talk about what the system consists of, and we will present it briefly during the internship). The fact is that particles of almost "spherical" shape result, but they can be deformed according to the treatments to which they are subjected and that they have diameters of the order of 100µm. Figure 1 shows light microscopy images of these microspheres when immersed in two different liquid media. As they are used in cell cultures, studying their behavior in different culture media is very important. We want to know if they swell or contract.
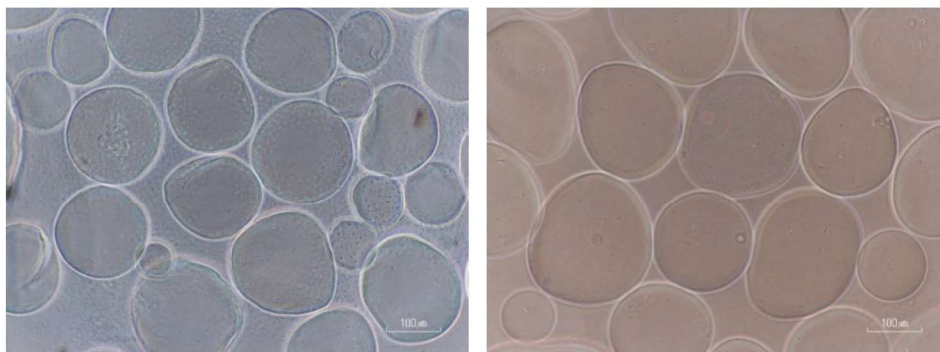

Figure 1. Optical microscopy images of alginate microspheres immersed in different liquid media.

To the naked eye, microspheres in the liquid medium in the image on the right seem to be somewhat larger than those on the left. However, it is not enough for us with that appreciation, we must "measure" them. First of all, you have to realize that not all microspheres are the same size or have the same shape. We must do a statistical analysis that in the end will tell us the average diameter of the particles the distribution of sizes around that average value, the circularity (that is, a parameter that says how similar the particles are to a sphere) and finally if the size of the microspheres changes significantly from one liquid medium to another.

To do this reliably, so that we reach conclusions that we are sure of, we have to analyze many microspheres, it would not be enough to measure those in these photos, we would need a high number of microspheres, maybe 50, to say a number (we will learn to determine the number of particles that need to be analyzed) and there will have to be a number of independent replicas of the experiment. Obviously, this cannot be done manually, we are going to use image analysis and statistical analysis software.

Another interesting example: Figure 2 shows two images of electrospun mats. These fibers are produced by passing a solution of a polymer (the one in the image is polyethyl methacrylate) through a needle subjected to a high voltage. The resulting electric field projects a jet of the solution onto a metal collector that is grounded. While the jet travels from the needle to the collector, the solvent evaporates and is deposited on the metal in the form of wires that can have diameters from tens of nanometers to a few microns depending on the conditions.
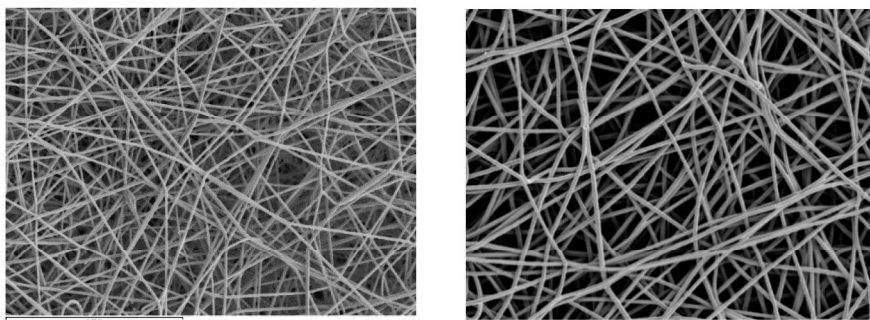

Figure 2. Scanning electron microscopy images of ethyl polymethacrylate electrospun fibrils produced by electrospinning under different process conditions.

The problem is the same as before, how do we measure the diameter of the fibrils? How do we characterize size dispersion? And finally, how do we conclude if there are significant differences in the average diameter between the fibrils on the left and those on the right?

A more complex example is to analyze the biological response of cells grown on a flat support. Figure 3 shows images of bone marrow mesenchymal stem cells, cells that have the ability to become cartilage or bone or fat cells in the laboratory. It depends on how the substrate on which we grow them, the cells adhere, adopt one form or another and proliferate more or less. To see the morphology, stains that fluorescently mark parts of the cell can be used. In this case the nucleus has been stained blue and the cytoskeleton of the cell, formed by actin fibrils has been stained red.
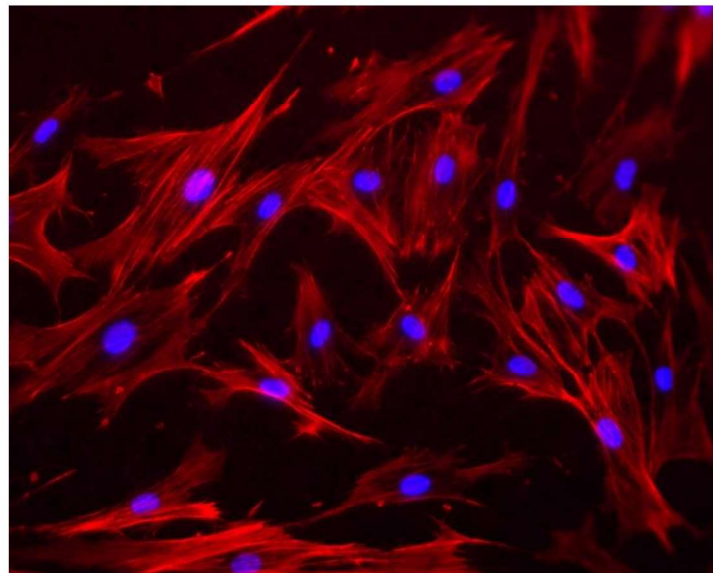

Figure 3. Fluorescence microscope pictures of mesenchymal stem cells grown on a flat substrate. The actin cytoskeleton has been stained in red, and the nucleus in blue.

Here we find complex shapes, our image analysis will allow us to determine the average surface of the cells, their circularity and dispersion in both values. It is already clear that dispersion in shapes and sizes is important, as always happens in the biological environment.

Lastly, as a fourth example, we will look at the analysis of histological images. Figure 4 shows light microscopy images of a thin slice of tissue from an animal's knee joint. Different stains mark the different components of the tissue, showing the cartilaginous region, the

bone below it (subchondral bone) and the trabecular bone below. It also allows, with greater magnification, to observe the cells dispersed in the tissue and the morphology around them.
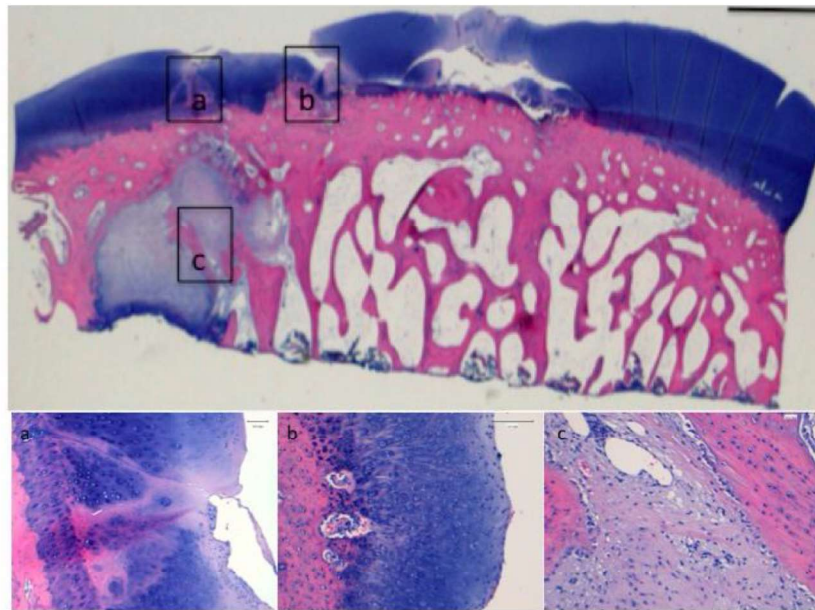

Figure 4. Histological staining of a cross-section in the knee joint in an animal model.

Here we may be interested in calculating the fraction of bone and cartilage at the interface, or calculate the number of blood vessels, number of inflammatory cells, measure thicknesses of the different layers etc. Again, it's something we're going to get from an image analysis combined with a statistical analysis of the data we get from it.

The internship is designed to be carried out in a group by between two and three people and supervised by a tutor of the company.

2. Objective.

The objective of the work is to analyze the morphology of different systems of interest in biotechnology companies:

1. Alginate microspheres in different liquid media: average diameters, size dispersion, circularity, from optical microscopy images.
2. Electrospun fabrics: average fibril diameter, size dispersion, number of nodes between fibers.

3. Cell morphology in cells cultured on flat supports: cell numbers per unit area, cell surface area and circularity

4. Morphological analysis of tissues from histological images.

In all cases, it will be based on images taken by the IKASIA Technologies team in collaboration with different academic entities and in different research projects. Also in all cases, special emphasis will be placed on the statistical analysis of the results found in order to determine if there are significant differences between different systems.

3. Telecommuting tools

The work of image analysis and statistical analysis will be carried out using open access software. It is important that all members of the group master the handling of the three essential tools that will be used at work. In this way, the work of analyzing the images of the different systems can be effectively distributed. It is also important because when it comes to learning the different tools contained in these programs, progress will be made much faster if each component of the group can help the others by transmitting what he has learned. Essentially the following software packages will be needed.

1. Image processing software.

We will use GIMP (from gimp.org) an image editing and digital photography program that may be more advanced than the image processing tools included in the analysis software that we propose below.

2. Image Analysis Software:

ImageJ is a public domain digital image processing program developed at the National Institutes of Health, USA. It allows you to identify shapes in a photograph, analyze them and calculate parameters that define sizes, surfaces, contours, tonalities, etc. At the end it collects in numbers the characteristics of the localized objects.

3. Statistical analysis software.

We will use the simplified version of Minitab of free access in educational programs and that will be sufficient for our treatment and is simple to use or PSPP which is an open source statistical package.

Besides these computer design and prototyping tools, teleworking tools are required. You need a stationary or laptop computer capable of installing the software packages we have described. It is also necessary to have access to a network with sufficient data transmission speed to maintain a telematic meeting with image and sound.

Also for teleworking tools we will use free access software.

4. Software to hold telematic meetings: We will use Skype or Google Meet

Its use is very simple and probably all students know it beforehand

5. Office automation software: Word processing, slide shows : We will use Open Office

It is likely that students know this software or other analogues, especially in the case of word processing, in any case, they will deepen in the different options and tools they contain throughout the internship.

6. Documentation repository.

The company will make available to the group a storage space for networked documentation where all the activity and results of the project must be recorded. There will be a folder for the group and another for each of the participants. In the latter, the individual worksheets will be saved, in addition to any results of the individually assigned tasks.

4. The working day.

This internship will be governed by teleworking rules. Whoever participates in the internship will perform a working day like another worker of the company, but the work will be done remotely. Teleworking has advantages and disadvantages. Taking full advantage of the advantages requires following well-thought-out rules and strategies as well as a clear commitment on the part of the worker to their productivity and the commitment of the company in terms of adjusting the tasks assigned to the worker to the working day.

One of the advantages of teleworking is the flexibility of the working day. In this internship in a work environment, the day will be 7.5 hours a day of which a minimum of 2 hours will have a fixed schedule, the same for all participants in the internship. It will be from 9:00 a.m.

to 11:00 a.m. and will be available for telematic group work meetings, meetings with the tutor or presentation of results. This schedule may be modified by the tutor throughout the internship depending on the progress of the work or the needs of the company. The rest of the working day may be fixed by each worker at their convenience. It is recommended that it be from Monday to Friday and the same every day of the week, although punctual variations can be admitted. The worker will notify the tutor of his schedule and will be available in that period of time to respond to communications with the company or with the rest of the members of the group. The day can be continuous or split. The start and end of the work will be recorded daily by means of a message in the group chat on Skype. If it is a split day with a long interruption period for example for lunch, the beginning and end of this interruption period will be recorded in the chat.

It is also recommended that breaks be made at work, these small breaks increase the ability to concentrate at work and your productivity. For example, you can rest 5 minutes after 25 minutes of work. These pauses do not need to be recorded in the chat.

IKASIA Technologies SL pays special attention to strict compliance with the working day, understood both in the productive fulfillment of the whole day by the worker and in the complete disconnection of work outside the working day. This requirement is especially important in teleworking where there is no such clear difference between the work environment and the worker's personal environment. Care will be taken to ensure that the work plan assigned is perfectly defined and that it is realistic and consistent with the working day. It is essential to maintain the effective activity during the working day to fulfill the planned tasks, it is not acceptable to prolong the working day because it has not been sufficiently effective in the marked time. In any case, it must be accepted that it may happen that the measure of the tasks scheduled for a specific day or days has not been realistic and the work plan has to be readjusted. These aspects should be discussed openly within the group and with the tutor.

5. Activity log sheets.

When working remotely, the worker is in an environment in which interaction with other workers in the company is limited both in time and by the fact of being telematics. In this

way of working it is absolutely advisable to establish at the beginning of the day an individual work plan for that day and end it with a review of the activities carried out. Attached below is a sample file that may be useful in this regard, in which we include some example of activity.

Date	Worker	
Planned activities	**Objective. Result to be achieved.**	**End-of-day commentary**
Group meeting	Today we have to talk about …	The meeting took place but I do not think we have reached clear conclusions. It will be necessary to continue talking about this point.
Retouching the contrast of images to allow recognition of shapes	Corrected image files	The files have been uploaded to the shared space of the group with file names: xxxxxxx, yyyyyy
Meeting with colleague xxxxxx to explain what it means and how to calculate circularity in a cell.	I think he knows how to do it and will save me work if he explains it to me.	The meeting is over and I think I understood the process. or We have not had much time to talk, I didn't understand it fully, we'll continue tomorrow.

These log sheets must be uploaded daily to the worker's individual folder in the shared space.

6. Group meetings.

The objective set out in this internship brings together a series of aspects that make it necessary to be addressed by a relatively large group of workers. On the one hand, it requires a high volume of work, probably beyond the reach of a single person in the period of duration of the internship. On the other hand, it is necessary to learn the use of techniques and computer tools autonomously. There will not be a teacher who explains every detail and to whom to consult every doubt. In these conditions, group work can multiply the results, what one does not know how to do may know how to do another, and the one who understands an aspect of what is being studied faster can explain it to others and save them time. Explaining something is the best way to understand and assimilate it.

It will be necessary to analyze in group the work of treatment of the images. The fact that there are different opinions is very positive. The criticism of the results that are obtained is essential to avoid mistakes and reach the best possible solutions.

The division of tasks should also be agreed at group meetings. In this internship, the tutor will not assign the tasks to each component of the group, although he can help in case of conflict. Nor will it be the tutor who judges in detail the fulfillment of the tasks by each one. One of the most difficult aspects, but one that must be learned, is to put on the table the breaches by some component of the group and do it in a way that encourages solving the problem rather than deepening conflicts. Also in this sense the tutor can be of help at some specific time, but it is the group who must adjust their modes of operation and generate dynamics that are motivating.

Group meetings are important for this, and the fact that they are dynamic and effective meetings is one of the keys of success of the project. Meetings can address issues such as:

- Brainstorming the approach to a specific task.

- Distribution of tasks.

- Report on the tasks performed: communicate to the group effectively the results of the tasks performed.

- Study sessions in which each component of the group exposes certain theoretical or practical aspects necessary for the development of the project, for example, image editing tools, or statistical concepts.

- Evaluation of the progress of the project.

- Preparation of the presentations of results to the tutor or the team of the company as a whole.

Some indications for group meeting to be effective:

- A maximum period of time should be determined for the meeting, which will depend on the objectives you have. There can be very short meetings, perhaps as little as half an hour for specific issues and long meetings of up to two hours dedicated to study sessions.

- The periodicity of meetings will depend on how productive they are. But OOO in the case of teleworking, each worker has only contact with others through telematic meetings. One should reserve a daily space to establish such contacts. From that point of view it would be convenient to fix the meeting daily at the same time, although some days there is not much to discuss and it ends quickly.

- Besides group meetings, meetings between two colleagues should not be spared for specific consultations. In this sense, it would be convenient to keep the teleconference channel open and to be able to make a call at any time during the working day.

- The agenda of the meeting must be fixed in advance, at the end of each meeting the agenda of the next can be set. However, at the beginning of the meeting the first item on the agenda may be to remember the agenda and decide whether to add or remove any items.

- The meeting must have a moderator. It must be chosen at the beginning of the meeting or rotated among the different components of the group. It is the role of the moderator to ensure that all points are discussed and conclusions reached within the time frame foreseen for the meeting.

- The meeting must have a secretary. It must also be a position that rotates between all the components of the group. You should write down the most relevant of the discussion, the conclusions and the agreements adopted. All this must be collected in the form of a record that will be uploaded to the shared space in the group folder. The minutes of each meeting shall be adopted at the next meeting.

7. Meetings with the tutor.

The tutor of the internship is a worker of the company, with his own tasks and responsibilities. The time you can devote to tutoring the work of the group is limited. That is why it is necessary to prepare well the meetings with him. In principle, ordinary meetings will be weekly, although extraordinary meetings may be convened at any time at the initiative of the tutor or the group. The meeting will consist of a presentation of the progress of the work by one of the members of the group. The activities carried out, the decisions taken, and examples of the results achieved will be explained. A slide show will be used for this. The duration of the presentation will be a maximum of 30 minutes and will follow a discussion in which the tutor will raise doubts or suggestions and the members of the group can also raise their doubts. The adequacy of the progress of the project to the planned schedule will be discussed and, if necessary, the group can consider the readjustment of the work plan.

8. Work plan.

In the work plan presented below, an attempt has been made to identify in detail all the tasks that need to be developed to achieve the objective of the project. We state them correlatively, with a small description, the period of execution time and the tangible results that must be obtained from them. In any case, the breakdown of tasks may not be complete and during the development of the project new ones are detected or any of the specified ones may be unnecessary. The group can make the necessary adjustments. There are tasks that must be performed by all members of the group, others for which only one of the components can be responsible or the work can be divided among several.

The internship is organized in three phases or work packages.

Phase 1. Understanding the problem. Training in teleworking tools.

Task 1.1. Understanding the problem.

Group meeting with the tutor. Problem statement. Objective of the project. Review of work organization strategies: group meetings, working day, distribution of tasks, periodic presentation of project progress… Computer tools.

Result to obtain: All the components of the group must have a clear idea of the objectives of the project.

Dates: Day 1.

Task 1.2. Installation of software on individual computers.

Each component of the computer can be responsible for searching for a tutorial or written instructions on the Internet for the installation and configuration of one of the necessary software packages and passing that information to the others. Each will install the tools on your computer. Communication between all members of the group is important to resolve doubts that may arise for one or the other.

Result to obtain: All the components of the group must have all the necessary software installed on their computers and configured.

Dates: Week 1.

Task 1.3. Statistical analysis.

Study of the fundamental concepts of statistical analysis: mean values, normal distribution, standard deviation. This information will be searched on the Internet or in basic statistical books.

Result to obtain: A slide show that collects the main concepts and equations. You should prepare to expose it to group peers in about 20 minutes. Documents with the downloaded information will be uploaded to the shared space in a specific folder within the group folder.

Dates: Weeks 1 and 2

Task 1.4. Digital image editing.

Basic concepts about photographic images. Luminosity levels. Color saturation. Contrast. Brightness. Information will be sought on the internet and in basic courses of digital photography. To clarify these concepts, examples will be proposed on the basis of an image of those that will be used in the work, changing the different parameters mentioned in the image processing program and analyzing the effect.

Result to obtain: A slide show that collects the main concepts with examples. You should prepare to expose it to group peers in about 20 minutes. Documents with the downloaded information will be uploaded to the shared space in a specific folder within the group folder.

Dates: Weeks 1 and 2.

Phase 2. Project execution. Design and construction of the prototype.

Task 2.1 Training in the use of the image analysis program.

This task will begin with an initial class taught by the tutor of the work, as a form of initiation to the use of the program. It will be in a theoretical-practical session of about two hours in which the components of the group will be doing on their computers the exercises that the tutor will propose.

From there, the group will deepen the management of the program while analyzing the images of the alginate microspheres. It is about seeing how each of the microspheres in a specific photograph identifies the program and how that identification can be improved or not by modifying the parameters of the image, passing the image to grayscale, adding contrast, or using filters. It will be seen how the program defines parameters such as the "diameter" of particle "circularity" and other parameters that may be of interest about the morphology of the particles. You will also see how the program stores the data it obtains and how it can be exported to perform statistical analysis.

Result to obtain: Ease in the management of the image analysis program. Obtain a dataset of microsphere diameters.

Dates: Weeks 3 and 4.

Task 2.2 Training in the use of the statistical analysis program

In the first place, we must consider what is the minimum number of elements or values that we must analyze so that the result we obtain from them (average values, standard deviation) are statistically significant. Next, with the data obtained in task 2.1 we will see the management of the program. We will see how to represent a histogram of particle sizes. It will be analyzed if the size distribution is a normal distribution, calculating mean values and standard deviation.

Result to obtain: Graphical representation of the histograms of particle diameters and circularity. Mean values and standard deviation.

Dates: Weeks 3 and 4.

Task 2.3 Are there statistically significant differences between the particle sizes of alginate microspheres immersed in water and immersed in the saline medium?

It is about applying what has been learned in tasks 2.1 and 2.2 to solve the first problem we face. We will have images of a large series of particles taken under the light microscope while they are submerged in one of the liquids we are interested in. Alginate is a gel that is obtained from certain algae and has a great capability for water absorption. Keep in mind that they are microspheres of the same series. That is, a high number of microspheres has been produced in the microfluidic circuit continuously. In a session with the tutor, he will show a video showing the circuit and production process of the microspheres. After washing, they are left in ultrapure water at pH7.

A part of the microspheres are passed to the saline medium and let them balance with it for 24 hours and then we take pictures of each other in the microscope (the tutor will also show a video of the inverted microscope, the placement of the sample and the way in which the images have been obtained). Therefore, if there are changes in size it will be because the balance with the medium containing the salts causes the alginate microsphere to either absorb more water and swell or expel part of the water it carries and contracts. That is what we want to determine. We will calculate the characteristic parameters of each of the series and determine whether or not the differences between the values found are statistically

significant. If somewhat different values are found, but without statistical significance, it must be concluded that the liquid medium does not affect the size or shape of the particles.

Result to obtain: Report of the results including the conclusion reached, but also the histograms of particle sizes, analyzed images, examples of the retouching made in the images to facilitate the identification of the microspheres if applicable, etc.

Dates: Weeks 5 and 6.

Task 2.4 Analysis of electrospun fibers.

This second problem that we pose is conceptually very similar to the previous one. Here we have to analyze a tissue consisting of fibrils of diameters of the order of the micron. We have a wide range of images taken in a scanning electron microscope, SEM. You can search for information on the internet about this microscopy technique. In a meeting with the tutor, he will show you a video about the device that allows electrospinning and will explain the physical foundation on which the technique is based. Image analysis can allow us to calculate a series of parameters of interest in the applications of these membranes. On the one hand, we will determine the distribution of fiber diameters, and we will analyze whether it is a normal distribution or not, we will calculate mean values and standard deviation.

We will also be interested in analyzing the free space left by the fibers between them, in what way can image analysis give us a quantitative data of that free space. That information can be very valuable if we want to apply these membranes to filtration or cell cultures. As in task 2.3, the fibers obtained with two different process conditions will be compared by determining in which parameters there are significant differences between them.

Result to obtain: Report of the results including the conclusion reached, but also the histograms of particle sizes, analyzed images, examples of the touch-ups made in the images to facilitate the identification of the fibrils if applicable, etc.

Dates: Weeks 7 and 8.

Task 2.5 Cell morphology.

Mesenchymal bone marrow stem cells have been cultured on two flat supports made of different materials. As shown in Figure 3, the nucleus of the cell has been stained in blue, with DAPI, and the actin cytoskeleton in red, with phalloidin. The cytoskeleton are fibers that form in the cytoplasm of the cell from the point at which the cell adheres to the support. These fibers maintain tension in the cell and its shape. Depending on how the cell adheres to the support it extends more or less and adopts shapes that can be rounded, stellate or more or less elongated.

The shape of the cell gives us information about the interaction between the cell and the material and is very important in the study of the biological response to biomaterials. Here, the characterization of the shape of the cell is much more difficult than in the two cases of tasks 2.3 and 2.4, which dealt with simple forms. The cell takes very complex forms with protrusions and, in addition, in many cases, the cells meet each other, and we have to identify where one ends and the other begins. It is necessary to have a certain level in the management of the image analysis program to face this work. An approach to discuss is whether the identification of the shape of a cell is done by hand, drawing its outline as one identifies it, or the software does it. The answer is probably that it depends on the image in question. There are times when the subjectivity that is introduced when it is the person who draws that outline is acceptable in the face of the error made by the computer in images difficult to segment. In the end we will determine the average surface of the cell and its size distribution, also circularity and cell density, the number of cells per unit area, which gives us an idea of proliferation.

Result to obtain: Report of the results including the conclusion reached, but also the histograms of cell size, circularity, the images analyzed, examples of the touch-ups made in the images to facilitate the identification of the cells if it is the case, or the contours drawn if in the end it has had to be done that way etc.

Dates: Weeks 8 and 9.

Task 2.6 Histology.

In this case, the analysis of a cartilage tissue is proposed. It is an animal model in which damage has been regenerated in the cartilage of the knee joint. There is a new tissue that has formed in the region where the defect was in the cartilage layer. We want to analyze the composition of that tissue and its organization to see whether or not it resembles natural tissue. For this, fine cuts of the tissue are made, fixed and stained with finished dyes that reveal characteristic components of articular cartilage tissue and also bone. We are interested to see if bone tissue has formed in the area that should have formed cartilaginous tissue and vice versa.

We have some optical microscopy images that show in different colors the layers of the different stained components. Cells in the cartilage, chondrocytes, which appear as small points enclosed in a more or less circular hole in the tissue (the lacunae) are also observed at greater magnifications. We will be interested in determining the proportion of one component and another in different areas of the image and also the number of cells per unit area of the image and if there is some kind of arrangement or they are randomly distributed. Image analysis should be able to distinguish the different shades in the image. The retouching of these images is very delicate because it is very easy for us to be altering the result

Result to obtain: Report of the results including the criteria used to decide in which areas of the image the analysis is made, and the conclusions reached.

Dates: Weeks 9 and 10.

Phase 3. Conclusions. Final presentation.

Task 3.1 Image analysis protocols.

At the end of this internship you must prepare a document with the explanation of the processes you have followed to reach conclusions from the image analysis. This document is very useful for those who write it because it makes them fix the ideas and concepts and assimilate them and it is very useful for those who later want to apply these same procedures because the way of explaining who has just encountered all the difficulties involved will be much closer to the one who begins to learn it. You are going to make him fall into the points

where the difficulties appear and how you have solved them. It can be much more effective than any manual and even more effective than the explanation of a very experienced person who perhaps already stops explaining many details because he considers them very simple. It is interesting to write these protocols at the same time that the work is done.

Result to obtain: Written document of the image analysis protocols

Dates: Weeks 5 to 12.

Task 3.1 Final presentation.

In the end it is necessary to prepare a written document that collects the studies carried out and describes not only the final result but the whole of the work done. It should contain:

- An introduction to the methods used.

- The most relevant decisions made regarding the analysis of the images.

- The report of each of the four problems raised, the result of the corresponding tasks.

- The strengths and weaknesses that have been found in each of the analyses.

There will be a public presentation of the study, with an approximate duration of 30 minutes. It will be a telematic presentation open to the staff of the companies and educational centers involved in the *VIRTUAL INTERNSHIPS IN TECH CENTERS: training VET students with obstacles into an innovative digital methods of remote working and e-Learning created from COVID-19.*

A short version of this presentation in video form will be prepared for publication as part of the project's outreach program. In any publication related to this work, the students who have participated in it and their tutor and those responsible for the work in the company, as well as those who have designed their objective and work plan, will appear as co-authors.

Result to obtain: Final written report and oral presentation.

Dates: Weeks 10 to 12.

9. Deliverables.

In this section we list the set of documents and other tangible results that must be delivered to the company throughout the development of the project.

E1.- Individual worksheets. Daily. Delivered to the individual folder of each component of the group in a subfolder with this name.

E2.- Minutes of group meetings and meetings with the tutor. Once approved by the group at the next meeting. The slide presentations used in the meeting will be attached. Delivered to the group folder in a subfolder with this name.

E3.- Report on morphology of alginate microspheres. Analysis files of results and images treated. Report text document, spreadsheets, files exported from statistical and image analysis programs. Delivered to the group folder in a subfolder with this name.

E4.- Report on electrospun membranes. Analysis files of results and images treated. Report text document, spreadsheets, files exported from statistical and image analysis programs. Delivered to the group folder in a subfolder with this name.

E5. Report on cell morphology. Analysis files of results and images treated. Report text document, spreadsheets, files exported from statistical and image analysis programs. Delivered to the group folder in a subfolder with this name.

E6. Report on histology. Analysis files of results and images treated. Report text document, spreadsheets, files exported from statistical and image analysis programs. Delivered to the group folder in a subfolder with this name.

E7. Image analysis protocols. Text documents. Delivered to the group folder in a subfolder with this name.

E8. Final report of the project. Text document. Delivered to the group folder.

E9. Final presentation. Slideshow file. Delivered to the group folder.

10 Timeline.

Task		Deliverable result and date.																
Phase 1																		
1.1	*Understanding the problem.*		█															
1.2	*Computer tools.*		█															
1.3	*Statistical analysis.*		█	█														
1.4	*Digital image editing.*		█	█														
Phase 2																		
2.1	*Image editing training.*					█	█											
2.2	*Training in the statistics program.*					█	█											
2.3	*Microspheres.*							█	█									
2.4	*Electrospun membranes.*									█	█							
2.5	*Cell morphology.*											█	█					
2.6	*Histology.*												█	█				
Phase 3																		
3.1	Protocols.									█	█	█	█	█	█	█	█	█
3.2	Report and final presentation.																█	█

critical
**Virtual Internships
in Tech Centers**
thinking

INTERNSIP MODEL FOR THE PROGRAMMING OF VIRTUAL ENVIRONMENTS

METHODOLOGICAL GUIDE: THE VIRTUAL INTERNSHIPS IN TECH CENTERS

1. Introduction and purpose of the internship.

The purpose of this internship is to create a simulated working environment reproducing a desktop setting of any PC office to allow remote working activities for internships. In order to make the user experience realistic, this simulated environment must include the standard features of a Windows machine. In addition, the simulator is required to have a certain flexibility to accommodate specific requests from the individual companies that will use it.

The specific needs may include, by way of example:

- A set of software tools specific to the task to be performed, depending on the host company.

- Internal messaging systems for the company staff.

- Automated / real-time reporting systems.

- Remote monitoring of the work hours at the terminal.

- Remote access to shared file systems of the company.

The objective is to create a tool to be offered to host companies, i.e. a platform to which the company can sign up, then create an account within which to register the staff, subdivided between trainees and tutors, with access keys, a personal profile, etc.

2. Objective.

The final goal is to create a tool that allows not to interrupt, in periods such as that of the Covid pandemic or in which for any other reason people are forced to work from home, some planned activities such as internships, in order to give continuity to training paths. In addition, such tools are made for taking advantage of a problematic situation to promote agile methods of working. In other words, to turn a problem into an opportunity.

3. Teleworking tools.

The work will be carried out using specific software tools. Different possible tools will be made available but only some will be chosen by the workers, according to the type of

development that they decide to carry out (see description later). It is important that all the members of the group master the handling of at least one of the dedicated software that are going to be made available for their work. In this way, work can be distributed effectively, but it is also important because when learning the different tools that these programs contain, progress will be made much faster if each component of the group can help others by passing on what they have learned. Essentially, the following software packages will be suggested:

1st alternative (virtual machine):

- *Vmware*: a software that creates a virtual machine (VM), virtualizing a set of hardware components for the guest operating system. VMware runs on Windows, Linux and Mac hosts, but there are also VMware bare metal hypervisors (VMware ESX and VMware ESXi), which run directly on the host's physical hardware.

- *AWS*: Paid hosting system that is used to give the virtual machine a public url address.

2nd alternative (online platform):

- *Adalo*: no-code platform used to develop web applications

Generic software:

- Software to hold telematic meetings: We will use *Skype* or *Google Meet.* Its use is very simple and probably all students know it beforehand.

- *Office Software:* word processing, slide presentations: use Open Office. It is likely that students are familiar with this software or other similar ones, especially regarding word processing, in any case, the different options and tools that they contain will be deepened throughout the internship.

- Documentation repository. The company will make a network documentation storage space available to the group where all the activity and results of the project must be recorded. There will be a folder for the group and another one for each of the participants. In the latter, the individual work sheets will be saved, in addition to any results of the individually assigned tasks.

4. The working day.

This internship moves by teleworking regulations. Participants will carry out a working day as another worker of the company, but the work will be carried out remotely. Telecommuting has advantages and disadvantages. Capitalizing on the advantages requires following well-thought-out rules and strategies as well as a clear commitment to productivity by the worker. On the other hand, the company needs to adjust the tasks assigned to the worker to the structure of the working day.

One of the advantages of teleworking is the flexibility of the working day. In this internship the working day will be 7.5 hours a day, of which a minimum of 2 hours will have a fixed schedule, common to all participants in the internship. This time frame will be from 9:00 to 11:00 and will be dedicated to remote group meetings / presentations, either among co-workers or with tutors. The rest of the working day may be set by each worker at their convenience. This schedule may be modified by the tutor throughout the internship depending on the progress of the work or the needs of the company. It is recommended that the working week should be from Monday to Friday and the schedule will be the same every day of the week, although specific variations can be accepted.

The worker will notify the tutor of his/her schedule and will be available during that period of time to respond to communications with the company or with the rest of the group members. The working time can be continuous or contain some short or long breaks. The beginning and end of the work will be registered daily by means of a message in the group chat on Skype. In case of a split day with lunch break, the start and end of this break will be recorded in the chat.

It is also recommended that the worker takes short breaks at work, since these short breaks increase the productivity and the ability to concentrate. For example, one can rest 5 minutes after 25 minutes of work. These pauses do not need to be recorded in the chat.

Smallcodes pays special attention to strict compliance with timing the working day, both in terms of being productive while at work and being disconnected from work when off. This is especially important in telecommuting in which there is no clear difference between working and personal environment.

Efforts will be made to ensure that the assigned work plan is perfectly defined and that it is realistic and consistent with the working day. It is essential to maintain the effective activity during the working day to fulfil the planned tasks, it is not acceptable to prolong the working day because it has not been sufficiently effective in the time set. In any case, it may happen that the estimated time for a specific tasks turns out to be unrealistic. In that case the work plan should be readjusted. These aspects should be openly discussed within the group and with the tutor.

5. Activity log sheets.

When working remotely, the worker finds himself in an environment in which interaction with other company workers is limited both in time and because it is telematic. Thus, it is absolutely advisable to establish an individual work plan for each day at the beginning of the day and end it with a review of the activities carried out. Below is a model sheet that may be useful in this regard, including some examples of such activities. No more than 10 minutes should be spent at the beginning and end of the day to fill in these forms.

Date	Worker	
Planned activities	**Objective. Result to be achieved.**	**End-of-day commentary**
Group meeting	Today we have to talk about …	The meeting took place but I don't think we reached clear conclusions. It will be necessary to continue talking about this point.
Decision on the approach to be used toward the construction of the virtual environment.	Selection of tool(s).	The required software has been chosen and downloaded.

Meeting with the tutor XXX in order to ask for help in making the virtual machine accessible from outside.	I think he knows how to do it and will save me work if he explains it to me.	The meeting is over and I think allis clear about the process. or We did not have much time to talk, it isn't clear to me still, we'll continue tomorrow.

These files must be uploaded daily to the individual folder of the worker in the shared space.

6. **Group meetings.**

The objective of this internship brings together a series of aspects that makes that so that it has to be addressed by a relatively large group of workers. On the one hand, it requires a high volume of work, probably beyond the scope of a single person in the duration of the internship. On the other hand, it is necessary to learn the handling of computer techniques and tools independently. There is not going to be a teacher who explains every detail and who to consult every doubt. Under these conditions, group work can multiply the results, what one person does not know how to do, maybe someone else knows how to do it, and the one who understands the fastest an aspect of what is being studied can explain it to others and save them time.

Explaining something is the best way to understanding it deeply and assimilating it. It will be necessary to reach agreements on the design of the product that is intended to be obtained. The fact that there are different opinions is very positive. Criticism of the proposals that arise is essential to avoid mistakes and arrive at the best possible solutions. The distribution of tasks should also be agreed in group meetings. In this internship, the tutor is not going to assign the tasks to each component of the group, although he/she can help in case of conflict. The tutor will not judge in detail the fulfilment of the tasks by each one either. One of the most difficult aspects, but one that must be learned, is to raise the issue of the non-compliance of some component of the group and do it in a way that encourages solving

the problem rather than delving into conflicts. Also in this sense, the tutor can be of help at some point, but it is the group that must adjust its modes of operation and generate dynamics that are motivating. For all this, the group meetings are important and the fact that they are dynamic and effective meetings is one of the keys to the success of the project.

Meetings can address issues such as:

- Brainstorming about the implementation of the virtual machine: settings, accessibility, graphical set up.

- Distribution of tasks: looking for information on existing implementation paths, coding of specific sub elements, looking for solutions to problems encountered in handling the software, internet queries...

- Report on the tasks carried out: communicate effectively the results of the tasks carried out to the group.

- Study sessions in which each member of the group exposes certain theoretical or practical aspects necessary for the development of the project.

- Evaluation of the progress.

- Making presentations of the results to the tutor or to the team of the company.

Some indications can be given so the group meeting is more effective:

- A maximum period of time for the meeting should be determined, depending on its objectives. There may be very short meetings, perhaps only half an hour for specific issues, and long ones of up to two hours dedicated to study sessions.

- The frequency of the meetings will depend on how productive they are. Nevertheless, in teleworking, each worker only has contact with the others through remote meetings. One should reserve a daily space to establish these contacts. From that point of view, it would be convenient to set the meeting at the same time every day, even though some days there isn't much to discuss and it ends right away.

- Besides group meetings, meetings between two colleagues for specific consultations should not be skimped on. In this sense, one should keep the teleconference channel open and be able to make a call at any time during the working day.

- The agenda of the meeting must be set in advance, at the end of each meeting the agenda of the next one can be set. In any case, at the beginning of the meeting, the first item on the agenda may be to review the agenda and decide whether to add or remove any items.

- The meeting must have a leader to organize the discussion. They must be chosen at the beginning of the meeting or rotated among the different components of the group. It is the function of the leader to ensure that all the points are discussed and conclusions are reached within the period of time set for the meeting.

- The meeting must have a secretary. It must also be a position that rotates among all the members of the group. He/she must write down the most relevant aspects of the discussion, the conclusions, and the agreements reached. All this must be collected in the form of minutes that will be uploaded to the shared space in the group folder. The minutes of each meeting will be approved at the next meeting.

7. Meetings with the tutor.

The internship tutor is a company worker, with his own tasks and responsibilities. The time they can spend tutoring the group's work is limited. That is why it is necessary to prepare well for meetings with them. In principle, ordinary meetings will be weekly, although extraordinary meetings may be convened at any time at the initiative of the tutor or the group. The meetings will consist of a presentation of the progress of the work by one of the members of the group. The activities carried out, the decisions made, and examples of the results achieved will be explained. A slide presentation will be used for this.

The presentation should be maximum of 30 minutes long, followed by a discussion in which the tutor will pose doubts or suggestions and the members of the group can also raise their doubts. The adequacy of the progress of the project to the planned schedule will be discussed and, if necessary, the group can propose the readjustment of the work plan.

8. Work plan.

In the work plan presented below, an attempt has been made to identify in detail all the tasks that need to be carried out to achieve the project objective. We list them consecutively, with a brief description, the execution time period and the tangible results that must be obtained from them. In any case, the breakdown of tasks may be incomplete and during the development of the project new tasks can be detected or some of the specified ones can be seen as unnecessary. The group can make the necessary readjustments. There are tasks that must be carried out by all the members of the group, others for which only one of the components will be responsible.

The internship is organized in three phases or work packages.

Phase 1. Understanding the problem. Training in teleworking tools. Preliminary solution.

Task 1.1. Understanding the problem.

Group meeting with the tutor. Problem Statement. Objective of the project. Review of work organization strategies: group meetings, working hours, distribution of tasks, regular presentation of project progress.

Result to obtain: The components of the group must have a clear idea of the characteristics required for the result to obtain.

Dates: Day 1.

Task 1.2. State of the art of similar solution.

Look online for similar platforms with analogous solutions, aimed at virtual interaction between co-workers, although not necessarily addressed to carrying out internships. The results of this search will have multiple purposes: 1) to identify other potential implementation paths, aside from the ones presented in this document; 2) to see specific functions in detail, that may or may not be included in the list presented before, and gain inspiration about how they are implemented.

Result to obtain: A presentation with slides collecting the results of the search, to be presented to the tutor in approximately 10 minutes. The documents with the downloaded information will be uploaded to the shared space in a specific folder within the group folder.

Dates: Week 1.

Task 1.3. Study and evaluation of alternatives and selection of the best fitting pieces of software.

Each team member will look for information about the pros and cons of each possible implementation path (including any relevant result from the previous task) and share the conclusions with the rest of the group. Pay special attention to the applicability of each path to the specific context of the project.

Result to obtain: After a discussion of the whole team, a decision will be taken for the definitive list of software needed to carry out the project.

Dates: Week 1.

Task 1.4. Installation of software on individual computers.

Each team member can be responsible for finding a tutorial or written instructions online for the installation and configuration of one of the necessary software packages and passing that information to the others. Each will install the tools on their computer. Communication between all group members is important to solve the doubts that any member may have.

Result to obtain: All the components of the group must have all the necessary software installed on their computers and configured.

Dates: Week 1.

Task 1.5. Preliminary design.

A draft project must be designed with the various steps explained, the paths to be followed, and the objectives to be achieved.

Result to obtain: a development program in the form of a folder with the set of software to be used, text files, images as example, and any other useful tool to start the practical part of the work.

Dates: Weeks 2 and 3.

Phase 2. Project execution. Development and design of the virtual environment.

Task 2.1. Set up of the desktop environment.

This is the first step of the implementation of the virtual environment: using the chosen tool(s) to create the basic simulated desktop environment with its access credentials.

Result to obtain: a working, usable, and accessible simulated desktop environment, although still lacking any specific functionality.

Dates: Week 3.

Task 2.2. Implementation of the basic functions of a Windows device.

Starting from the virtual desktop environment set, include the basic applications and functionalities necessary to fully simulate a Windows environment, such as a calendar, a calculator, a file explorer… Install the most commonly used applications too, like a web browser, an Office suite or equivalent, and communication tools (Skype, Zoom, others).

Result to obtain: a fully simulated and fully functional Windows environment based.

Dates: Week 4.

Task 2.3. Inclusion of an internal messaging system.

The project requires the interns that use the simulated working environment to quickly and effectively communicate with their tutor and potentially with other colleagues in the hosting Company. An internal messaging system should be developed and pre-installed in the virtual environment, allowing the user to exchange messages only with colleagues within the

working group or unit (those with the same system installed on their -virtual or physical- PC). The interface should be composed of a widget-style panel always visible on the desktop, as well as a notification system to let the user know when there is a new message.

Result to obtain: a working instant messaging system running within the simulated environment, allowing for swift communication within the team.

Dates: Week 5.

Task 2.4. Implementing an automatic time counter to monitor work logs.

In order for the tutor to monitor the students' working hours, as well as for the students themselves to keep track of the time spent on each task of their project(s), the virtual environment must keep track of the working sessions, including log-in and log-out times and duration of each session, by automatically switching on and off a timer/counter when a user logs in or out of the virtual environment. This counter should have a graphical interface displayed on the desktop, showing the duration of the current session (and potentially the main statistics of previous sessions).

Result to obtain: a working tool integrated in the simulator, comprising an automatic switch, a clock and a graphical interface in the form of a widget.

Dates: Week 6.

Task 2.5. Preparation of an installer for external software.

So far, the simulator consists of the Windows environment, some integrated tools (either existing or coded ad hoc), and some pre-installed software. The objective of this task is to allow future users of the simulator to install more pieces of software as they would on their own PC, thus allowing for a potentially unlimited use of the simulator itself. This will enable the simulated environment to allow software to be installed by final users is not as straight-forward as it may seem, and some investigation (online or on manuals) and some trial and error is likely to be necessary from the team members, before having it working properly.

Result to obtain: final users should be able to install any piece of software on the simulated just like they would on a physical machine.

Dates: Week 7.

Task 2.6. Identification and implementation of the necessary steps to make the virtual environment remotely accessible via browser.

First, team members have to investigate and identify possible paths and the necessary steps to make the virtual environment they have been setting up this far remotely accessible, not only via the remote desktop application, but via web browser. This is a necessary requisite to make it really universal and for anyone to use (and any company to adopt it as a tool).

Secondly, those steps will have to be made so that everything that the team has been working on so far can actually be accessed remotely.

Result to obtain: a working URL address through which the virtual environment can be reached and used. This is the final step of the project and once it has been completed, deliverable number 3 can be considered done and ready.

Dates: Week 8.

Task 2.7. Concreting a virtual device with specific requirements based on the platform developed so far.

Students have to make assumptions about the type of company to whom the software they have developed may be targeted. Based on that, they will list the software needed and any other possible personalization that such company may require. Then, they will proceed with setting up a virtual machine, based on the simulated environment they have been working on this far, that fulfils all the assumed requirements.

Result to obtain: deliverable number 4, consisting of a working instance of the simulated Windows machine, comprising a suite of software that has been assumed needed by an hypothetical client.

Dates: Week 9.

Phase 3: Conclusions. Final Presentation.

Task 3.1 Final Presentation.

At the end it is necessary to prepare a written document describing not only the final result, but also the whole work carried out. This should have:

- A summary showing the final result, highlighting its main features.

- The most relevant decisions made regarding the platform developed, clearly justifying why a specific development path was adopted and the alternatives that were discarded.

- Different screenshots of the relevant parts and functions of the application.

- The user guide.

- A discussion of the result obtained, highlighting the strengths and weaknesses of the development, the points where further progress could be made, or those problems that have remained unresolved.

Make a team presentation approximately 30 minutes long, telematic, open to the staff of the companies and educational centers involved in the project "VIRTUAL INTERNSHIPS IN TECH CENTERS: training VET students with obstacles in innovative digital methods of remote working and e-Learning created from COVID-19".

A short video version of this presentation will be created and published as part of the project's dissemination program. In any publication related to this work, the students who have participated in, their tutor, and those responsible for the work in the company will appear as co-authors, as well as the person who has designed their objective and work plan.

Result to obtain: Final written report and oral presentation.

Dates: Weeks 10 to 12.

9. **Deliverables:**

In this section we list the set of documents and other tangible results that must be delivered to the company throughout the development of the project.

E1.- Individual work sheets. Daily. Delivered in the individual folder of each component of the group in a subfolder with this name.

E2.- Minutes of group meetings and meetings with the tutor. Once approved by the group at the next meeting. The slide presentations used in the meeting will be attached. Delivered in the group folder in a subfolder with this name.

E3.- Installer of the virtual environment including all customizations.

E4. Final report of the project. PDF format.

E5. Practical example of virtual environment applied to a specific company context.

10. **Timeline.**

Task		Phase
Phase 1		
1.1	*Activity 1.*	█
1.2	*Activity 2.*	█
1.3	*Activity 3.*	█
1.4	*Activity 4.*	█
1.5	*Activity 4.*	░█
Phase 2		
2.1	*Activity 1.*	░░█
2.2	*Activity 2.*	░░░█
2.3	*Activity 3.*	░░░░█
2.4	*Activity 4.*	░░░░░█
2.5	*Activity 5.*	░░░░░░█
2.6	*Activity 6.*	░░░░░░░█
2.7	*Activity 7.*	░░░░░░░░█
Phase 3		
3.1	*Activity 1.*	░░░░░░░░░░█

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CERTIFICATION AND EVALUATION OF THE MOBIITY

METHODOLOGICAL GUIDE: THE VIRTUAL INTERNSHIPS IN TECH CENTERS

9.1. PROCESSES OF MONITORING AND CONTROL OF STUDENT'S WORK

9.1.1. The laboratory notebook

The main monitoring and control mechanism of student mobility is the LABORATORY NOTEBOOK, a daily working document whose structure not only allows students to deal with specific aspects for their training in critical thinking, but is also an effective tool for the tutor to carry out the monitoring and evaluation of the work done by the student during a mobility, since it allows to trace the trajectory of the work done by a student in the company, thus becoming an essential tool to collect protocols, methodologies and experimental results.

Each day of work the student will fill in the laboratory notebook with all the information of the tests carried out, from the protocols and methodologies used, to the processes and tests carried out, and the results obtained.

Therefore, with the laboratory notebook, the tutor of the technology company and the VET center can closely follow the work of the students, evaluating if they have understood the assigned task, its objectives, their role in the whole project, the methodology they are using, the results and their repetitiveness, and their ability to express themselves and present the results to a work team.

To carry out the monitoring through the laboratory notebook, the tutors of the company and the educational center just need to download the APP "On your Side", created within the framework of the Erasmus+ Programme project "VET STUDENTS INTO TECHNOLOGY COMPANIES" of the CRITICALTHINKING4VET network. From it, they'll be able to access the daily laboratory notebook of each student to keep track of the work they do, as well as to provide comments that may be relevant, not only so that the students better understand the essay and its results, but to solve doubts that may arise in the process.

In this sense, the laboratory notebook is an effective digital tool for the monitoring and evaluation of those students who carrying out the mobilities in technological companies,

whether on-site or virtual, because with the digitization of this notebook you can know closely at all times the work they are carrying out.

9.1.1.1. STRUCTURE OF THE LABORATORY NOTEBOOK

PART 1: APPROACH

At the beginning of the laboratory notebook, the student makes an introduction of the work to do. To do this, start with a short description of the test you are going to carry out, in which you will indicate the area of the company or project within which it is included.

The laboratory notebook is divided into three parts that will allow the tutors of the technology company and the educational center to carry out an exhaustive monitoring and evaluation of the work carried out by the student.

Subsequently, the student, through key tools of critical thinking, exposes the problem to be solved, formulates a hypothesis of what they believe will happen, as well as the solutions they may need to possible difficulties that arise during the process and the results they hope to get.

The next step in this section is to indicate both the methodology and work plan to use for the test, as well as the measures they will adopt to prevent occupational risks.

Lastly, they must include the documents they have with information to carry out the test.

PART 2: RESULTS

This section constitutes the bulk of the laboratory notebook, because in this one they will expose day by day the tests that they carry out, as well as the results that obtained. Throughout this part, they will develop key critical thinking skills, as they will evaluate their own way of reasoning, accepting that sometimes they can be wrong, reflect on the problems that arise, learn to ask the relevant questions to advance in the essay, look for information

to acquire new knowledge, and above all, they must be persevering and not give up on complex problems. All this, through a clear written communication.

PART 3: ANALYSIS

At this point in the laboratory notebook, the student has already completed their test and it is time to assess the results obtained.

First, they need to analyze whether the result obtained matches the expected result. Analyze whether the hypothesis formulated in the first part of the notebook matches the result, and if not, they'll have to examine why they expected a different result. Thus, through key mechanisms of critical thinking, students will understand their whole test and all aspects that have been different from what they expected at first.

Secondly, they will have to assess the ability of the test to be repeated, and therefore, whether the result is accepted as valid.

Third, they will show notes of the most relevant conversations they've had with the tutor of the company and the center, as well as with the members of the team.

And lastly, they will explain the conclusions of the test. For this, they should indicate the solution to the problem raised in Part 1 and detail the conclusions reached on the work carried out, the procedures used, etc.

9.1.1.2. LABORATORY NOTEBOOK TEMPLATE

This experimental laboratory notebook model was developed by the IKASIA Technologies SL team during the Erasmus + 2017 project 2017-1-ES01-KA202-038469 *"CRITICAL THINKING AS A STEP FORWARD IN VET EDUCATION: VET students immersed in high technology teams"*.

PART 1.- Approach		
Title:	**Folder/server*:**	**Date:**

Brief description:

Area of the company or project in which it is framed:

The problem at hand:

Hypotheses, solutions that can be anticipated, and expected results:

Methodology and work plan:

Elements of occupational risk prevention:

Initial information available (include brief summary or notes of the documents already available, include the documents in annexes in the working folder indicating their name or reference of the file)**:**

(Include as many pages as needed)

PART 2.- Results A		
Title:	**Folder/server*:**	**Date:**

Additional information obtained during the task: alternative test methodologies, sources with which to contrast the data obtained, etc. Include these files as annexes in the folder, indicating there the name or reference of the file.

Experimental protocol (if there is already a written protocol in the company, just indicate its reference; if not, briefly detail the steps of the experimental procedure)**:**

PART 2.- Results B		
Title:	**Folder/server *:**	**Date:**

Experimental results (both taken by hand or printed by the device, they can be copied or scanned and copied here, such as images, videos, photos, and other materials added as attached files in the folder, indicating the name or reference of the file)**:**

(Include as many pages as needed)

PART 3.- Analysis		
Title:	**Folder/server*:**	**Date:**
Assessment of the result: assess the reproducibility of the test, does it match what was expected? If so, why did you expect a result very different from what ended up happening?	**Is the result accepted?**	
Notes on conversations with the supervisor or other team members:		
Conclusions (propose here the solution to the problem posed, but also detail conclusions about the task itself, about the experimental procedures, suggestions for new tests etc.)**:**		

9.2. MECHANISMS FOR THE CERTIFICATION OF INTERNSHIPS

9.2.1. The Digital Badge

The digital badge is a certification in image (.png) format that contains metadata accrediting the achievements, skills, and learning experiences acquired. In our case, the objective is to develop digital badges that recognize the participation of students in the virtual internships, once they have met all the evaluation criteria.

Digital badges establish a common framework for the recognition of skills and competences between companies, professionals, and educational centers.

Digital badges are issued through an Open Badge Standard (openbadges.me), and students will be able to access them through the Open Badge Passport.

Openbadges.me, is an online software with a free version available, certified by IMS Global Learning Consortium for the Open Badges v2 standard. This software allows to design and issue digital badges with tools like:

- Adding icons and text with different fonts.

- Digital badge templates.

- Tools to define the criteria to obtain the badge.

- Import images.

- Add custom attributes.

These badges include at least: the data of the entity issuing the badge, of the person receiving it, the knowledge acquired or activity carried out, and the process of acquiring this

knowledge and skills. Once the students finish the virtual internship period in the technology companies of the network, they will receive an email notification with an access to obtain the digital badge, which they'll be able to download to their computer and/or create an Open Badge Passport account in which to upload and manage all their digital badges.

Thus, through this method, students will be able to accredit the completion of virtual internships and the knowledge acquired throughout this period.

9.2.2. Personal accreditation certificate

All companies that host internships must issue a certificate to these students once they have completed their virtual internships. Certificates are a demonstration of the acquired learning. In the case of internships in companies, these certificates accredit the completion of the internship by the student. To get it, the student must have attended to 100% of the days that encompass the virtual internships.

Certificates must contain the following data:

- – Name and surname of the person who has carried out the internship.

- – DNI/NIE of the person who has completed the internship.

- – Name and VAT nº of the host company or entity.

- – Start and end date of the internship.

- – Total number of hours of the internship.

- – Knowledge that has been put into practice during the internship.

- – Signature of the person in charge of the host company or entity.

CERTIFICATE OF ATTENDANCE

Name of the host institution / enterprise:

_____

IT IS HEREBY CERTIFIED THAT:

_____

from the educational center:

_____

Attended the training activities specified under the ERASMUS+ programme at our institution/enterprise between ___ of _____ and the ___ of _____ of 20__

Developing the following tasks:

- *Identifies the company's structure and organization, relating it to the production and marketing of the product and services offered.*
- *Applies labour and ethic habits in his/her professional activity according to the characteristics of the job position and the procedures established by the company.*
- *Assembles computer systems, following the processes of the established quality system.*
- *Participates in breakdown diagnosis and repair applying corrective maintenance techniques.*
- *Installs operating systems and applications following the work plan and customers' needs.*
- *Participates in the installation, implementation and maintenance of installations with local network services and Internet, documenting the intervention.*
- *Helps users, solving problems related to the operation of applications, in accordance with the company's regulations.*
- *Participates in the tasks of installation, implementation and maintenance of systems that manage contents, e-learning and files among others, following the established work plan.*

Date   Stamp and Signature
- - - - - - - - - - - - - - - -   -

Name of the signatory:

Function: …………………………………………

9.2.2.1 Differences between diploma, certificate, and degree.

A diploma is a document that demonstrates the attendance to a certain event or course, both on-site and virtual, but it doesn't show the acquisition of knowledge. A diploma can be issued by an academic institution, a company, or even an individual.

A certificate, as we have explained in previous paragraphs, demonstrate the acquired learning or having carried out an internship in company. In this sense, even if a course is not recognized by an official body, the accrediting certificates serve to prove that a certain person has acquired the knowledge taught in that course.

Degrees are documents issued by governments through academic institutions, and prove general knowledge in a discipline and specialized knowledge in a subject.

9.2.3. Certification and validation of internships for ECVET credits.

There is currently no regulatory framework that establishes the transfer and validation of EVCET credits for a virtual internship. However, the Recommendation of the European Parliament and Council of 18th June 2009 on the establishment of the European Credit System for Vocational Education and Training (ECVET) states that:

"ECVET is applicable to all learning outcomes that can, in principle, be achieved through different education and learning pathways at all levels of the European Qualifications Framework for Lifelong Learning ('EQF'), and are subsequently transferred and recognized."

Therefore, in this section we'll seek to offer all the relevant information on the European Credit Transfer System for VET (ECVET) for student mobilities.

ECVET is a European Union initiative adopted in 2009 with the aim of supporting learning, student mobilities, and the flexibility of learning pathways for the transparency, transfer, accumulation, and recognition of learning outcomes.

Learning outcomes define the skills, competences, and knowledge a student has acquired after completing a learning process through the learning pathway, the mode of teaching, and the learning context (formal, non-formal, and informal). In turn, the results are grouped into "Learning Outcome Units", to which a number of ECVET points are assigned.

Once learning outcomes are assessed, they constitute ECVET credits, which can be accumulated or transferred.

In this sense, credit indicates the assessed learning outcomes that a student has obtained, while points offer information about the structure and description of grades and units, regardless of whether they have been obtained or not.

HOW THE ECVET CREDIT SYSTEM WORKS

Before the mobility

Two binding agreements must be signed by the sending and hosting entities and the student.

On the one hand, entities must sign the Memorandum of Understanding (MoU), which defines the framework for the mobility period, formalizing the ECVET partnership and cooperation procedures. On the other hand, the entities and the student must sign the Learning Agreement (LA), a document that not only establishes the knowledge, skills and competences that the student must acquire during the mobility period, but also the terms for the evaluation, validation, and recognition of the learning outcomes.

After the mobility

After the end of the mobility period, the hosting entity will evaluate the student's learning outcomes and draft a final evaluation report that will be provided to the sending entity to validate and recognize the ECVET credits that the student has obtained.

During the mobility

The student must meet the requirements set out in the Learning Agreement and obtain the knowledge, skills, and competences in the form of one or more units.

9.2.3.2. Evaluation and validation of the ECVET Credit System.

The evaluation is the set of processes through which it is assessed to what extent a student has acquired the knowledge, skills, and competences stipulated in the agreements prior to the mobility period. This is a process that must be carried out throughout the mobility period and culminates in the final evaluation and validation of ECVET credits. For it, it is necessary to draft a final evaluation report in which the hosting entity evaluates the learning outcomes, based on the agreements signed prior to the mobility period (MoU and LA).

This report consists of a grid to be filled in by the tutor of the host entity in which he will evaluate the knowledge and skills acquired by the student, assessing the level of quality of the expected results. After completing the final report, the host entity will provide the sending entity with the completed grid and a written statement from each student who has completed the internship, in this case virtual, in which they explain the achievements and progress acquired.

Lastly, the sending entity shall make use of the documentation provided by the hosting entity to carry out the confirmation of the assessment and validation of ECVET credits, in accordance with the table in Annex 2 of the Memorandum of Understanding (MoU).

How can virtual internships be accredited? Could the center accredit them with ECVET credits even if they are virtual? Could the center accredit the completion of internships without ECVET credits?

The higher education centers aspire to gain a quality reputation by being accredited by internationally recognized awarding bodies. The accreditation leads to and provides quality assurance for education or work experience and training. Although distance learning becomes a significant part of the education system in the 21st century, there is still a common opinion that the quality of distance education is lower when compared with the classical conventional classroom education. The accreditation will serve public accountability and play a critical role to change this opinion.

Moreover, we assume that any kind of learning or training should be completed or standardized with its the evaluation, and should follow the requirements that apply for its accreditation even in the case of remote learning. As a result, **ECVET credits can effectively be utilized in virtual internships too**.

To be more precise, the philosophy followed on an onsite learning internship is similar to the virtual one, regarding that in both on-site and online environments of the trainees in a work place they are supported by the school tutors and the company leaders, and consequently they can be evaluated. The school has the opportunity to create the specific learning agreements, and the performance or development of the student's learning can be evaluated on a daily, weekly, or monthly basis, depending on the pre-arranged standards. Thus, the company will evaluate the trainees and provide the corresponding **ECVET credits**, **the Europass and the certificates.**

COVID-19 accelerated the rise in remote work in a way that no one could have predicted. Traditional working ways were overturned in a heartbeat and replaced by new forms of working and training.

After overcoming the initial adjustment period, many organizations have realized the value of working with a remote team; yet in order to fully leverage the benefits of a global workforce, we as educators first need to know how to be well-organized, creative, good communicators, strategically thinking team leaders, and act as role models.

9.2.3.3. Glossary

LEARNING OUTCOME: the set of knowledge, skills, and abilities ACQUIRED by a student after completing a learning process.

LEARNING UNIT: a set of knowledge, competences, and skills that can be evaluated and certified.

ECVET POINTS: As stated in the "*Recommendation of the European Parliament and Council of 18th June 2009 on the establishment of a European Credit System for Vocational Education*

and Training", ECVET points are "a numerical representation of the overall weight of learning outcomes in a qualification and the relative weight of units regarding qualification".

ECVET CREDITS: these are the set of learning outcomes that the student has acquired, and which have been evaluated.

ACCUMULATION OF ECVET CREDITS: this is the process by which the student acquires grades through the assessment and validation of units of learning outcomes.

TRANSFER OF ECVET CREDITS: this is the process by which the learning outcomes that the student has acquired in one context can transfer to another.

MEMORANDUM OF UNDERSTANDING (MOU): an agreement that sets out the working conditions of the partnership regarding the objectives, length, and modes of revision of the agreement itself. In this document the partners specify their respective criteria and procedures of quality, safety, evaluation, validation, and recognition of skills and competences for the transfer of ECVET credits.

LEARNING AGREEMENT (LA): this is a document of agreement between the sending organization, the hosting organization, and the student, stating that the hosting organization will evaluate the learning outcomes acquired by the student and the sending organization will validate and recognize them according to the established rules and procedures.

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RESOURCES AND HELP

METHODOLOGICAL GUIDE: THE VIRTUAL INTERNSHIPS IN TECH CENTERS

10.1. DIGITAL TOOLBOX of the CRITICALTHINKING4VET network.

DIGITAL TOOLBOX is a digital environment that allows the free access to all resources, tools and protocols to implement a virtual internship system in 5 different jobs.

THE DIGITAL TOOLBOX is a tangible result created by the partners of the Erasmus+ project "VIRTUAL INTERNSHIPS IN TECHNICAL CENTERS: TRAINING VET STUDENTS WITH OBSTACLES IN AN INNOVATIVE DIGITAL METHOD OF REMOTE WORK AND LEARNING CREATED FORM COVID-19", in order to make all the resources accessible to structure learning and protocolize the monitoring of the work done.

From the digital toolbox users have access to:

− **TOOLS:** this section is divided into the 5 jobs. Each section contains a set of tools that facilitate to carry out the virtual internships.

− **COURSES:** this section includes the course developed within the framework of this Erasmus+ project, focused on the employability and inclusion of VET students with obstacles in technology companies: The digital course: e-Learning simulation environment in technology centers.

− **SIMULATORS:** from the menu, students can access the simulators of the 5 jobs mentioned, being able to carry out the simulation of one or several cases.

JOBS

1. Design and rendering of 3D models.

2. Design of electronic circuits.

3. Construction of 3D printing machinery.

4. Laboratory technician.

5. Programming digital environments.

10.2. OTHER RESOURCES:

10.2.1. Virtual Educational Resource Platforms

VIRTUAL INCLUSIVE EDUCATION (VIE)

This is a smart educational e-Learning platform specialized in the third sector, designed to help and support both social and educational entities, their members, and beneficiaries. It has a system capable of defining the user's profile (their previous knowledge, languages, strengths, and weaknesses in their education…), and consequently create personalized learning strategies.

They offer a simple but powerful tool for training, and to develop competences and critical analysis skills through a digital educational process adapted to the needs and characteristics of the user. From specific courses for NGOs and school headmasters to social technicians, teachers (in language courses, project management, working with beneficiaries, innovative methodologies…), and the beneficiaries (of learning courses, inclusion processes, language courses, networking, resources, etc.).

Through innovative programming, they not only offer a way to study through the smartphone, tablet devices, or the PC wherever and whenever you want, but also a platform that will automatically analyze your current level of knowledge and customize a learning itinerary specially adapted to your needs, structured in several levels of difficulty.

The VIE platform offers an innovative learning process based on five principles that provide a great learning capability for its users:

- **A NEW EDUCATIONAL METHODOLOGY**

It promotes an innovative pedagogical methodology based on the creation of specific educational itineraries adapted to the characteristics and previous knowledge of the users. To do this, users fill a brief test when starting a new course, which sets its level and itinerary, define its content index, and establish the questions of the final test. The working methods are based on digital processes through specific ICTs that promote a guided distance study based on active, collaborative, and self-learning learning.

- **CREATION OF SPECIFIC EDUCATIONAL AND PEDAGOGICAL MATERIALS**

It includes educational courses that allow users to follow a personalized itinerary, most of them for free and others, due to their specialty, require logging-in. These courses are compact modules classified according to the knowledge they develop and according to the legal framework of the European Union.

- **A MODERN AND DYNAMIC PROGRAMMING**

It allows users to track both their learning and their participation in training activities. In this way, learning is transformed into an enriching experience with didactic materials, communication tools, ICTs, multimedia resources, and collaborative and educational management.

- **DIGITAL TOOLS FOR LEARNING**

It puts at the disposal of users digital tools that allow them to establish a synchronous and asynchronous virtual learning in which the user can have real-time conversations with tutors and peers, and send them messages and files for evaluation.

In this way, they promote a collaborative learning that generates networks of joint work between very different people, allowing users to offer new ways for inclusion and facilitating them to successfully overcome the proposed educational processes.

- **A LEARNING CERTIFICATION SYSTEM**

It has an automatic system of evaluation and accreditation through two ways: on the one hand, the creation of personal

certificates that certify the completion of each course, specifically showing the level and itinerary passed.

On the other, it generates a series of digital badges -icons with specific integrated information about the learning achieved- that can be validated by educational institutions and accreditation platforms.

These badges don't just safely and reliably certify the work and educational field of the courses passed, but also the specific competences in which the user has excelled. In addition, they are compatible with the system of the European Europass Curriculum, allowing to strengthen your CV, and with it, your employment opportunities.

ONLINE LANGUAGE SUPPORT (OLS)

This is a free online language learning platform designed for participants of the Erasmus+ Programme and the European Solidarity Corps. This platform allows to test your level in the language of the stay abroad, and offers the opportunity to learn collaboratively and work with other students.

The flexibility of the platform allows you to work at your own pace, adapting learning to the needs of each user. OLS provides a wide range of opportunities to improve language skills. You can choose to follow MOOCs (Massive Open Online Courses) or online classes (tutoring sessions) with native speakers and other OLS participants. OLS is available in 24 languages.

STEPS TO ACCESS LANGUAGE SUPPORT

1. Test your level. First test the level of the language you want to learn.

2. Learn. You will improve language skills through a flexible learning methodology that allows you to adapt to your needs. It's a great way to complete your language learning anytime, anywhere you want.

3. Evaluate progress. Take a second test to find out how much you have improved, unless you have obtained the maximum score in your first test.

A higher education, VET student or an Erasmus+ volunteer who has been selected for an Erasmus+ or European Solidarity Corps Programme can access the OLS. They will receive an invitation e-mail with their login details.

ETWINNING

The eTwinning platform was created in 2005 as the most important initiative of the European Commission's e-Learning Programme, but it was in 2014 when it became part of the Erasmus+ Programme, as a tool aimed not just towards school education, but also towards VET.

Thanks to this platform, the teams of the European educational centers have access to learning, communication, collaboration, and project development tools, once they are registered. Likewise, through ICTs, it promotes school collaboration in Europe by encouraging participation and cooperation between teachers, students, schools, families, and local administrations.

The objective of eTwinning is to encourage and provide contact, exchange of ideas and collaborative work between teachers and students from participating countries of any subject and/or stage of pre-university learning.

BENEFITS OF THE PLATFORM

▪ COOPERATION. A key point in eTwinning is cooperation between teachers, students, schools, families and local authorities. In eTwinning, teachers work as a team to organize activities for their students, offer them an active role, interact, investigate, make decisions, respect each other and learn twenty-first century skills.

▪ PROFESSIONAL DEVELOPMENT. This platform offers the student the possibility to attend free didactic meetings and webinars with experts from very diverse fields, while learning and discovering new pedagogical materials with the outstanding activities, professional development workshops and annual conferences.

▪ RECOGNITION. It includes a section that contains all the information about the work done by teachers, students and educational centers through European quality labels, national quality or eTwinning Center, as well as project awards.

SCHOOL EDUCATION GATEWAY (SEG)

SEG is a free online portal with resources in 23 languages, including Early Childhood Education and Care, and VET focused on teachers, schools, special schools, and other professionals in the education sector. The objective of the platform is to provide schools with all the general information about the Erasmus+ Programme, and give the necessary help to start and develop projects. Therefore, it is considered an opportunity for teachers, educational centers, experts, and interested parties in the field of teaching.

It includes the section "Teacher Academy", in which it provides a centralized course catalog with information on on-site job training courses, as well as free online courses developed by teachers of eTwinning, European Union institutions, and projects funded by the European Union. It's a resource that allows teachers to discover a wide range of training opportunities and resources for their classroom.

BENEFITS OF THE PLATFORM

- ACCESS TO INFORMATION: it includes new content each week, including expert opinion articles, news articles, interviews, updated publications, and practical examples.

- ACCESS TO RESOURCES: from SEG you can access recent research reports, pedagogical materials created in projects, European training courses, and tools for educational centers.

- ACCESS TO TRAINING: the Teacher Academy allows to access free online courses developed by SEG experts, as well as webinars and pedagogical materials.

- ACCESS TO INFORMATION ON THE ERASMUS+ PROGRAMME: the platform offers resources to familiarize you with Erasmus+ funding and opportunities for schools to draft their Erasmus+ applications, such as: course catalogue, directory of mobility opportunities, and search for strategic partnerships.

EUROPASS

EUROPASS is a free set of online tools that allow to manage competences, skills, qualifications, and plan learning and careers.

All of it through documents that help potential employers, educational centers, and training providers to understand what subjects have been studied, what training has been completed, or what work experience has been acquired.

EUROPASS DOCUMENTS

- Passport of Languages.

- Europass supplements.

- Mobility Document.

- Certificates of studies or work.

Thus, Europass becomes a personal electronic dossier containing an electronic curriculum vitae (CV) and a portfolio of documents in which you can record all your work experiences, education, training, language skills, digital skills, information about projects, volunteer experiences, and any achievements you consider important. Europass allows to:

- Create a personal record.

- Identify your capabilities.

- Receive personalized job suggestions.

- Prepare and track job applications, and develop resumes (CVs) and cover letters.

- Store all documents.

It also includes other tools for communicating the student's competences in Europe. In this way, we find three documents that provide useful information to help the user search for courses and apply for a job: the European Diploma Supplement (EDS), which provides information on higher education degrees; the supplement to the Europass diploma or certificate, which provides information on VET qualifications, and the Europass Mobility Document, with which the user describes the skills acquired during mobilities in Europe (for studies, work, or volunteering).

10.2.2. Addresses to download free software for virtual internships.

Design and rendering of 3d models

- **FREECAD.** https://www.freecadweb.org/downloads.php

- **SLIC3R.** https://slic3r.org/download/

Build a 3D printing machine

- **FREECAD.** https://www.freecadweb.org/downloads.php

- **SLIC3R.** https://slic3r.org/download/

- **Freedyn.** http://www.freedyn.at/download/freedyn/

Programming digital environments

- **INTELLIJ IDEA.** https://www.jetbrains.com/idea/

- **GLIDE.** https://www.glideapps.com/

Electronic circuit design

- **KICAD.** https://www.kicad.org/

- **OPENOFFICE.** https://www.openoffice.org/?redirect=soft

Laboratory technician

- **GIMP.** https://www.gimp.org/downloads/

- **IMAGEJ.** https://imagej.nih.gov/ij/download.html

- **PSPP.** https://www.gnu.org/software/pspp/get.html

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CONCLUSIONS

METHODOLOGICAL GUIDE: THE VIRTUAL INTERNSHIPS IN TECH CENTERS

The virtual internship program in technology companies that we propose in this project can be used in several directions. It is particularly aimed at facilitating carrying out internships in companies of VET students in circumstances in which for personal or social reasons they have obstacles to access them. Students with fewer resources or other obstacles can take advantage of this system to carry out international mobilities, but it can also be useful for students in general in situations such as those they had to face during the COVID-19 pandemic and other crisis situations that impact a country or a region.

In this type of situation, virtual mobilities are an incredibly valuable contribution to the training of VET students, opening the way to a very satisfactory career personally, and very fruitful for society. However, it is not easy to replace the internship in a work environment with a virtual internship; one needs a very careful planning and a real conviction in the students, teachers, and tutors, and the benefit that this will suppose for the three actors of the process: the student, the educational center, and the company. This is due to the methodology we propose, whose training capability we are convinced of, since it is an extra effort for students and tutors compared to more conventional approaches. Pay special attention to the motivation of students and their tutors.

The first point we emphasize is that the work proposed to students must be a creative professional work; we must flee from a routine job in this first work experience. This work has to trigger in the student the desire to advance in their training continuously throughout their career.

Secondly, bear in mind the change of working ways from the study in an educational center to the work in a company. Our methodology has to help this transition, and our approach is that the way to help the student to become a creative professional is to train them in critical thinking skills. The student has to go from accepting what is in the notes or books or what a teacher says to judging the reliability of the information they receive for themselves, analyzing the reasoning they develop, or the opinions of co-workers, being critical of the results they get, and being integral in their relationship with themselves, their colleagues, and the company for which they work.

Regarding group work, the methodology must also help to train in teamwork tools, more specifically in group work tools in virtual environments. In this sense, the virtual internships that we propose answer to a need of companies that emerged with the COVID-19 pandemic, which is the need to train workers for teleworking. Students will be able to show a training in teleworking tools in technology companies in their curriculum.

Consequently, we think that, for a VET student, carrying out these internships can imply a huge leap in their abilities and their perspective regarding their professional career.

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