PROPOSAL OF A LEARNING DESIGN MODEL DEVELOPED FOR THE CREATION OF TRAINING COURSES
COBOL PROGRAMMING COURSE CASE STUDY

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ABSTRACT

In this paper we present a model for designing professional courses in a blended learning context as a tool to help the interaction between students, teachers and learning resources.

This model aims to promote new concepts, new approaches and new strategies that have been changing the paradigm of teaching and learning. To develop a course based on these objectives, a systematic process, driven by a series of well-defined phases and activities, is required to help us to effectively develop high-quality applications. The research presented here focuses on an improved design model in a blended learning context and consists of four main phases: requirements definition, planning, design of learning activities, implementation, and evaluation. The whole process begins with an analysis of the students and the characteristics of the environment. Content analysis is conducted to explore the structure of the course. The identification of learning events, learning units, and instructional methods are included in the design of learning activities. As evaluation is a critical factor, this model incorporates a questionnaire, whose purpose is to ensure a well-designed blended learning course. This questionnaire tries to answer the key points that determine the structure of the course and to check the satisfaction of the learners with the context taught. One of the main contributions of this research is allowing the requalification of professionals who meet the needs of professional staff in Information and communications technology (ICT).

KEYWORDS

Blended Learning, Collaborative Tools, Distance Education, Online Learning

1. INTRODUCTION

SARS-CoV-2, known as the coronavirus, has drastically changed the routine of the world population. Organisations have had to adapt to the new context, especially educational institutions, reinventing themselves with technological tools and instruments that allow teachers and students to continue their teaching and learning processes.

At an early stage of this pandemic, the Ministry of Education did not foresee the cancellation of teaching activities and those educational institutions would comply with the recommendations of the General Health Directorate (DGS), such as the distance of individuals and the use of a mandatory mask. These rules obliged educational institutions to apply a hybrid teaching model that would allow students to have both face-to-face and online classes. This model implied that online classes were alternated with face-to-face classes, allowing the reduction of the number of students travelling to school across several classrooms, given the high number of students per class. Based on these premises, it was necessary to restructure the vocational training courses, namely their design. This restructuring aimed to reflect on the strategies to be created, on new practices and methodologies to be applied to analyse and define new forms of assessment.

2. TEACHING HYBRID

In the educational scenario, proposals have emerged that combine active methodologies in hybrid contexts, joining the classroom to online learning, thus emerging the so-called hybrid education.

Hybrid Learning is a teaching methodology that combines online and offline learning spaces, mixing moments in which the student performs activities in the virtual environment with others in which learning occurs in person, reinforcing peer interaction and between the student and the teacher (Moran, 2015).

This teaching methodology stands out for its flexibility, mixing and sharing spaces and activities, making hybrid education "a formal education programme in which a student learns at least in part through online learning, with some element of control over the time, place, mode and/or pace of study, and at least in part in a supervised physical location outside their home" (Christensen *et al*, 2013).

To apply this type of teaching methodology, it is necessary, considering the materials available and the students' profile, that learning focuses on collaboration between the actors in the environment. Hybrid teaching allows students to study at their own pace and devote more time to the subjects that interest them most; it allows them to interact with colleagues and teachers, and to take responsibility for their own learning. Therefore, personalisation and teaching, in hybrid form, is related, e.g., personalisation is enabled by Hybrid Learning (Fagundes *et* al., 2021).

2.1 Types of Hybrid Education

Teachers who apply hybrid teaching in their curricular units can opt for different modalities. The most well-known modalities are the following (Evolua, 2020):

Flipped classroom - this is a different concept, which has nothing to do with the position of the chairs in the classroom. What changes is the concept of a place of learning. Students learn at home through online classes. The time in the classroom is used for additional projects spent by the teacher or instructor.

Rotating lab - this type is very similar to the previous hybrid learning. The difference is that here the online learning period takes place in a specific laboratory provided by the school. Allowing the student to have contact with other education professionals.

Flex - the basis of this model is e-learning and personalised teaching. Here everything is flexible: the hours of face-to-face classes, the support of the teachers, the subjects to be taught. With that, everything must adapt to the student's profile.

Hybrid Collaborative Synchronous - Feature's classroom communication, with teacher support for face-to-face and remote students. Using tools integrated with a learning platform, students can establish synchronous or asynchronous communication.

2.2 Aspects to Consider When Designing Courses

Hybrid education, as we discussed in the previous section, consists of integrating technology, which is very present in students' lives, with education. It mixes traditional methodologies with interactive methodologies. However, it is not enough to place a few computers in classrooms and let students' study on their own. According to Evolua (Evolua,2020), the organisation of the classroom, the preparation of the teaching plan and the control of school time are issues that are questioned in any course proposal with these characteristics. When we decide to design a course, we should pay attention to the following aspects.

2.2.1 Application

For hybrid teaching to be applied effectively, the focus of discussions should be on personalising learning, both for students and for trainers and/or teachers. From there, one can think about infrastructures, training of trainers and/or teachers. Here we are talking about education associated with technology, so investment in technological equipment is paramount. It is investing in Internet packages and in the computers offered, these will be decisive for the development of the work.

2.2.2 Rotations

There are two types of rotations in hybrid education. To share, the student's experience of the learning journey and the student's interaction with technology are considered. Let us see:

Rotation of seasons - the school builds its students' learning journey based on the seasons. Students alternate the way they learn per term, one of which is entirely online.

Individual rotation - the student rotates the learning according to the seasons. However, the schedule control is carried out individually by a teacher or software. Thus, the maximisation of the personalisation of teaching is considered here. The management of the rotation is done according to the profile of each student.

In addition to the models described above, there are 2 more:

A la carte - This model is 100% online. The course is entirely online, and the student also contacts the teacher/trainer. Therefore, besides ensuring the personalisation of teaching, it is a great choice for schools that cannot offer specific professionals in cases of free courses.

Virtual enriched - The virtual enriched type of hybrid education is ideal for schools that are fully online. It follows the concept of the flipped classroom with the difference that face-to-face meetings, although mandatory, do not require daily attendance.

2.2.3 Advantages of Hybrid Learning

One of the advantages of hybrid education and the most significant is the greater involvement of students, it allows the student to be the protagonist of their own learning. With this, they learn more and better prepare themselves for the labour market.

For the students, it is a way of offering a quality and differentiated education that solves their needs.

Teachers, on the other hand, are empowered to teach through collaborative learning, demystifying their role as holders of knowledge.

Another positive point of hybrid education is the possibility of a school management system. Thus, we can reduce bureaucratic processes and automate them, in addition to saving time. The system will monitor the school's results.

Another aspect that we can consider, is hybrid business education, which besides being an alternative to traditional education, hybrid education is also present in the business world. Study has no age and keeping up to date is essential. This type of education being highly flexible is its main difference. It has a direct positive impact on productivity.

3. COURSE DESIGN MODEL

As mentioned in the introduction section, the pandemic led to teaching being adapted and the teaching-learning process being restructured. To minimise student contacts at school, the teaching-learning process in our educational institution started to operate by alternating face-to-face teaching with online teaching. This required mental and technical preparation of teachers and students, and it was necessary to implement the courses with several additional tools and activities to support the communication between these actors. The general framework and main elements comprising the courses taught during the pandemic period were developed as shown in Figure 1.
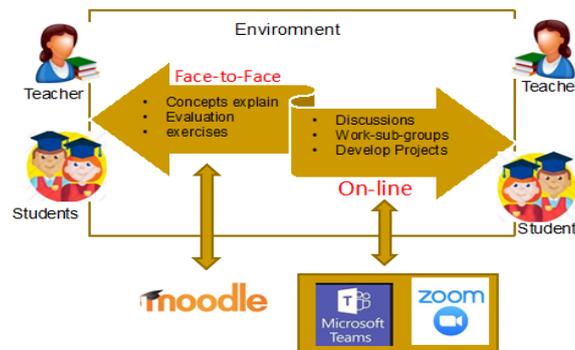

Figure 1. A general framework of learning approach for building courses with lectures, laboratory classes and other activities

The face-to-face learning component aims to allow course content and learning material to be taught in person to a group of students. The learning is essentially a teacher-centred teaching method and the interaction between student-student and student-teacher is more active, ensuring a better understanding and recall of the lesson content.

The online component aims to allow the teacher to have the mission of facilitating learning and motivating the student to perform their tasks autonomously. The teacher needs to remain flexible and ready to assume any necessary role (e.g., guide, coach and/or student) to maintain the focus on learning (Ramos, 2018).

The student becomes more autonomous, and has a more active attitude, and their responsibility in learning. However, to be able to implement the course, we need to do more demanding development work and acquire new and challenging skills (Addis, 2009).

One of the aspects to consider when implementing this type of course is the interaction between the two stakeholders, which according to our point of view should be provided by the course design. This interaction depends on the learner and the intended effectiveness of the course, so it is necessary to take into consideration some artefacts, which are:

1. clear learning objectives.
2. find the right blended learning model that works for the organisation and the learners.
3. learning must be ubiquitous.
4. microlearning (we should use easy to understand elements like bullet points, quizzes to increase students' involvement).
5. evaluation in e-learning.

3.1 Course Design Steps

The design of courses, whether they are intended for vocational education students, requires a development methodology that goes through several interconnected phases and leads the development team to consider several essential aspects such as collaborative work, assessment, active learning techniques. This allows learning activities that involve a systematic combination of face-to-face interaction and technology-mediated (online) interactions between students, teachers and learning resources to offer greater flexibility and deeper learning. In this sense, the course proposal presented here considered several phases, as shown in figure 2.
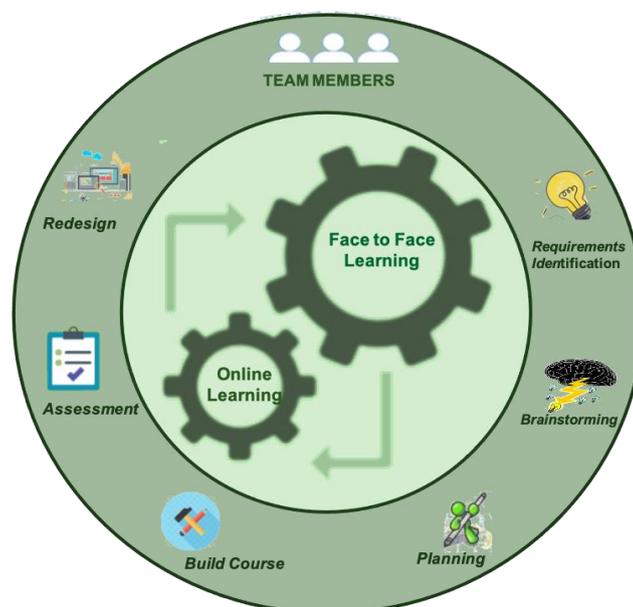

Figure 2. Design course phases

The first two phases, called requirements identification and brainstorming, allow us to achieve a balance between the two learning models (face-to-face and online), being necessary to define the instructional objectives, identify the characteristics of the students (target audience), define the online resources available, choose the platform that will host all the contents and activities related to the course, define the types of interaction and the method(s) of student assessment and, finally, define which collaborative platform to adopt in the online model. The second phase, called planning, follows on from the previous two, allowing teachers to define a training plan, which will be supported by the virtual learning environment chosen for the course, which will also include distance sessions. After identifying these points, we can start implementing the course and, during this phase, we should make an evaluation, to achieve the proposed requirements. This will help the course participants to improve the course design to include the following teaching strategies, as we believe they can contribute to improve the course design:

- Process-oriented - progressive activities that culminate in performance or evaluation (e.g., peer reviews, brainstorming sessions, etc.)
- Project-oriented activities that go step by step, with benchmarks that the students should perform in a certain order. The outcome is not the only important thing here, but the way students create the project is also important (e.g., case studies, online group collaboration, blogs, etc.)

When designing the course, we should keep in mind that students should have time to think about what they know and what they do not know about the subject in question. Thus, we can achieve an optimal environment for metacognitive development (McGee & Reis, 2012). Do not forget that this will only be possible if the technology we incorporate in the course is simple and free, so that students can engage it and can use it according to their needs.

Finding the right balance between face-to-face and online activities are the biggest challenges of designing such a course. The course structure should be carefully created with the learner at the centre of the redesign. Sessions should not be randomly held online or in class, but rather complement each other to take advantage of the online or in class environment. Figure 3 shows the different phases and the different artefacts to be built for our model to be proposed.
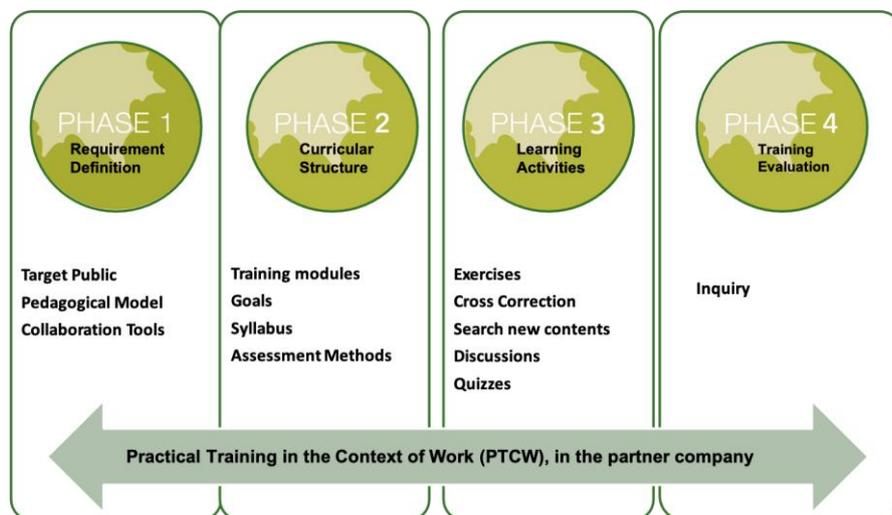

Figure 3. Stages of development of the proposed model

4. CASE STUDY

The study focused on the development of a programming course in Cobol, which took place within the Upskill programme. This training course with the duration of 700 theoretical and theoretical-practical hours is carried out on a work basis, in the facilities of PORTIC - Research, Technology and Innovation Centre of Porto, 7h/day and 5 days/week in schedules that can go from 8:00 am to 6:00 pm and up to 35 hours per week.

The objective of the course was to allow trainees to receive training based on training references, methodologies, and work processes, applied to their professional output in accordance with the conditions of health, hygiene and safety at work required by the legislation in force.

Based on these assumptions, we will demonstrate all the steps taken to achieve the proposed objective, where we intend to create an educational scenario that combines active methodologies in a hybrid context, combining the classroom with online classes, making use of Digital Information and Communication Technologies.

4.1 Definition of Requirements

4.1.1 Target Audience

The target audience, trainees, of the course are employed and unemployed people, preferably with training levels 3 to 6 of the National Qualifications Framework (NQF), which can also cover levels 7 and 8 of the NQF. The target audience should preferably be people who are unemployed and underemployed at the time of enrolment in the course (Proença & Marques, 2020). A situation of underemployment is one where the person holds a contract to perform functions or services for which the qualifications required are lower than those held by the contractor.

Trainees have certain obligations, which are:
1- Each trainee may not record more than 10% of absences which are measured according to the workload of the theoretical training course. If he exceeds 5% of justified absences, he loses the right to the training grant, maintaining the right to meal allowance. In the case of exceeding 10% of absences, justified and/or unjustified, it is the responsibility of the IHE training manager to approve the continuity of the trainee in action, provided that, according to the opinion of the training team, this does not prevent the trainee's certification and if there is evidence of recovery work done by the trainee. But absences that occur for reasons such as illness, family assistance, provision of assessment tests, or others foreseen in the Labour Code, are justified. Proof of the reason for the absence must be provided within a maximum period of 5 consecutive days from the day of the facts that gave rise to the absence.
2- Attend the training course with assiduity and punctuality to acquire the theoretical and practical knowledge given, in accordance with the Internal Regulations in force for theoretical and practical training.
3- Use carefully and ensure the proper preservation of equipment and other property entrusted to them for training purposes.

4.1.2 Pedagogical Model

Considering the specialised and intensive nature of the training that requires a very close follow-up of the work done by the trainees in a tutorial logic, the pedagogical model has the following format:
- classroom training, corresponding to 50% of the theoretical training hours.
- Non-contact training, in asynchronous mode, corresponding to 50% of the theoretical training hours, oriented towards the development of autonomous work by the trainees, in a logic of exercise / project / work accompanied by the trainer / tutor.
- the evaluation of the training in the different modules is supported by the development of exercises / works / projects by the trainees which allow the training of the acquired skills and their demonstration in results made available to the trainers / tutors.
- The training is organised by a team of trainers coordinated by a person in charge of organising the content of the training and supervising the team of trainers.
- the training has a Scientific-Pedagogical Manager.
- the scientific-pedagogical manager will liaise with the companies to ensure that the contents and projects carried out throughout the course are consistent with the type of competencies and activities that are expected to be accomplished in the FCT and in the context of professional integration.
- It is also foreseen that the scientific-pedagogical supervisor will monitor the activities developed by the trainees during the FCT, through mechanisms of regular contact with the trainees and the tutors in the companies.

The model may have to be conditioned by the contingencies resulting from the pandemic, and in defined circumstances it may be necessary to move from face-to-face to distance learning in synchronous mode if there are indications from health authorities for this to happen. The technical conditions for the transition to distance learning are fulfilled if this proves to be mandatory.

4.1.3 Collaboration Tools

Collaborative tools help to promote interaction between students and student teachers. In a distance environment, all interaction is mediated through a technological medium. Since the proposed model is based on blended learning and some training sections will be carried out at a distance, it was necessary to choose a collaborative tool. Thus, the platforms used during the training to support face-to-face and online classes were -Moodle and MSTeams. Both platforms were properly configured to support the designed course and the students who would attend the course were enrolled on them (Proença & Marques, 2020).

4.2 Curricular Structure

This course implemented, was intended for trainees with any area of origin. With this principle, its content was initially designed to provide and level the basic concepts, followed by the more practice-oriented component of programming in Cobol language (Proença & Marques, 2020).

The programming component in Cobol language is divided into two training units, one for the programming itself and the other for the laboratory where trainees are expected to apply the skills acquired or developed in the previous training units in the analysis, design, and programming of applications specially prepared for this purpose.

There are several variants of the Cobol programming language. With this observation in mind, the Programming training unit is designed to contain a generic and more specialised component - adaptable for each edition - in the desired Cobol variant.

The course also includes a training unit on emotional management with the aim of providing trainees with motivation, resilience, and strategic skills to manage emotional states, preparing them for job interviews and teamwork.

With this training action, the trainee acquires knowledge and skills to:
  - Develop programs in Cobol language.
  - Understand and evaluate the best way to store data.
  - Analyse a problem in a structured way.
  - Design a problem solving with recognised standards.

The modular list of the "Cobol" training course with a duration of 700 hours, regarding its theoretical component, is presented in the following table (Table 1), to which 480 hours of Training in the Work Context (TWC) are added.

Table 1. Theoretical component of Cobol

Modules / Training Units Theoretical Training Component	Total (hours) 700h
Emotional Management in Professional Reframing	60
Introduction to Programming	120
Information Representation	60
Programming	320
Laboratory	140

4.3 Curriculum Plan

In this section, information is presented on the curricular plan and on each of the training units that make up the modular list of the "Cobol" training action lasting 700 hours, on its theoretical component (see Table 2). The content can be adjusted according to factors considered relevant by the training team (Proença & Marques, 2020).

Table 2. Curricular Plan of the Training Unit: Introduction to Programming

Training Unit: Introduction to Programming		**Hours:** 120 hours, compulsory, 60 hours synchronous.
Objectives	**Content**	**Evaluation**
Understand and apply fundamental programming concepts. - Identify the requirements of a problem, analyse it, create an algorithm for its computational solution and design an appropriate test plan for its validation. - Understand and apply the software development process. - Understand the concept of programming language. - Identify the most widely used languages and their field of application. - Understand the concepts of source, object, and executable code.	Algorithmic - Algorithm testing - Good practices in application development - Application development life cycle - Programming languages - The programming process: source code, object, and executable code - Compilation errors and execution errors	Daily worksheets submitted on Moodle - Group work and presentation - Two assessment tests, the second being taken in the last session of the module - Classroom performance and posture evaluation

This course is intended for trainees with any background area. On this basis, its content is designed initially to provide and level basic concepts, followed by the more practice-oriented component of programming in the Cobol language.

The Programming training unit is designed to contain a generic and more specialised component - adaptable for each edition - to satisfy the Cobol language variants in the intended Cobol. Issues such as access to existing and/or to be created data in files of various formats are the subject of a structural viewpoint in the programming unit and applied in the laboratory unit.

At the end of the course, trainees are expected to be trained to evaluate, analyse, and program in Cobol.

Students at the end of the training unit must take a theory examination. However, each training unit has another assessment method, shown in figure 4.
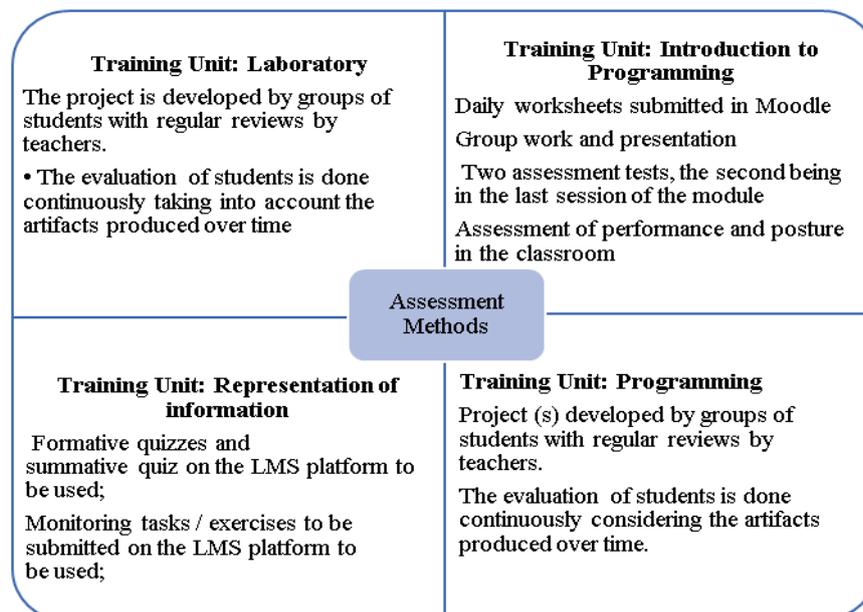

Figure 4. Assessment methods for each training unit

4.4 Learning Activities

A variety of in-class and online activities were used during the training. Some activities occurred in many of the units while others were specific to one or two units. For example, in the Introduction to Programming training unit, students developed a project in an iterative process where they applied all the learning concepts

in unit. the iterative process was chosen because it is systemic. Each cycle follows a specific structure or guideline so that structural changes can be made in each cycle. This creates a gradual but constant improvement on each previous cycle, which means that each new cycle is one step closer to the final[1] goal. Other types of activities carried out in class and in online context were exercises, quizzes, online discussions, Q&A Blogs and Virtual Brainstorming Sessions.

Students developed questions to share perspectives or develop an argument to share with the class, engage in group discussions and collaborate on tasks as a group.

4.5 Evaluation of Training

At the end of the training, a questionnaire was applied to assess trainees' satisfaction and collect information that would help us identify whether the type of resources and strategies were the most appropriate.

The questionnaire was anonymous, and based on the objectives, it sought to highlight the trainees' reaction to the training action in relation to the pedagogical strategies, the trainers' performance, the resources, and the pedagogical material. It was also sought to highlight the perception of learning and involvement in the training, in relation to questions that led them to reflect on the level of learning achieved in each training unit. Finally, questions of an open nature were elaborated with the objective of seeking to involve the trainees in the process of improving the training, presenting related questions in which they are invited to point out the weak and strong points observed, especially to identify possible improvements in future editions.

As for the type of questionnaire, we considered the multiple-choice format, but most questions assume the degree of satisfaction/dissatisfaction and good/very good. For this reason, we used a Likert scale with 4 levels, which semantically indicates opposite positions, "Insufficient", "Sufficient", "Good" and "Very Good". This method allows obtaining complex and subjective information, such as perceptions, attitudes, representations, preferences, and opinions (Cohen *et al.*, 2007).

The matrix in Table 3 shows the structure and nature of the questionnaire, as well as the scales that were adopted for each theme.

Table 3. Structure and nature of the questionnaire

Dimension	Topics	Likert Scale
Speech by trainers	Mastery of the themes	Insufficient/Sufficient/ Good/Very Good
	Methodologies used	
	Language used	
	Commitment and support to trainees	
	Relationship with trainees	
Training Units	Suitability for the course	Yes or No
	Workload	Insufficient/ Inadequate/ Too much
	Methodologies	Not Adequate/Adapted
	Considerations about the training unit	Open response
Suggestions/criticisms	Themes considered most important	Open response
	Themes to be developed in greater depth	
	Other topics to be included in the action	
	Suggestion of training actions in which you would like to participate in the future	


[1] https://businessterms.org/iterative-process/

4.5.1 Results of the Evaluation

Within the scope of this work, although giving an overview of the results obtained, we will focus our attention especially on the training component that took place in this environment. Thus, we will analyse aspects related to the intervention of trainers and training units because it allows us to characterise the group of trainers who carried out the training and to verify if the contents are adequate for the course.

Out of the 10 trainees, 10 responded to the questionnaire, which corresponds to 100% of the total number of participants in the training.

Regarding the face-to-face meetings, a good level of satisfaction was observed, with emphasis on the items "Effort and support to trainees" and "Relationship with trainees". Regarding the distance sessions, some dissatisfaction was pointed out at the level of interaction, which is explained from the open questions.

Graph 1 shows the results for each of the items evaluated in relation to the Intervention points of the trainers and, effort and support of the trainees and training units.
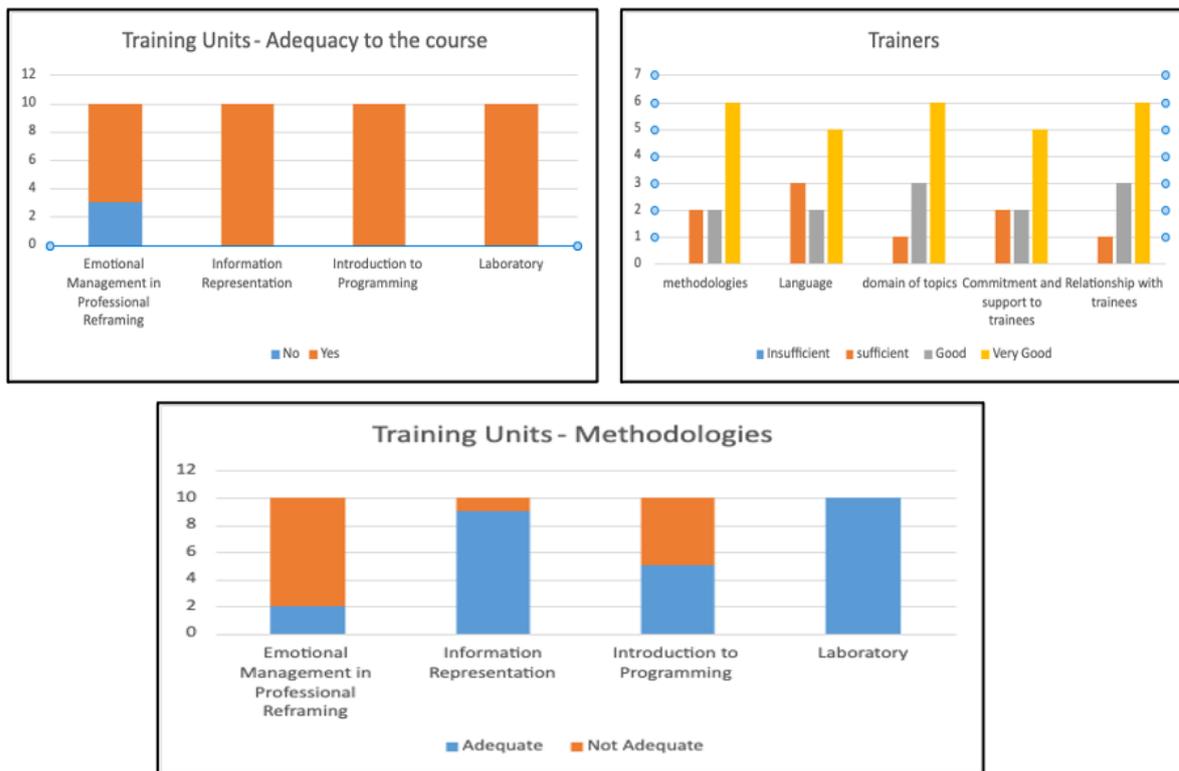
Graph 1. Results for each of the items assessed

The aspects related to the structure of the course, collaboration tools, and which competences acquired will be further analysed when the trainees are still doing internships in companies.

5.   CONCLUSION

Despite the opinions that covid-19 and its restrictions brought only negative effects, it is also necessary to indicate the positive consequences of closing the negative effects. One such effect is related to the schools of the university. The new reality and unprecedented circumstances have forced a radical need to quickly introduce and use all available technologies and tools for distance work and communication. (Ozadowicz,2020). The learning system had to be restructured, both at the level of teaching technologies and various types of classes and student activities.

In this sense, we intend to demonstrate with this work that the design of courses should be thought considering these circumstances, because we believe that in the future teaching will not be the same, and that blended learning will bring more advantages. These bring benefits, both for the students themselves, who have grown up surrounded by technological innovations, especially mobile devices that they have been using daily, and for the teachers for whom new and better electronic tools and systems, LMS and other software platforms are being developed.

Considering all the benefits of blended learning, we believe that the proposed model described and substantiated with the case study, can help to better educate students in vocational education. Therefore, our intend that individual with academic qualifications at the 12th year and university level, at areas of competence different ICT, will be able to acquire competences in this area and may enter the professional milieu. We believe that having a partnership of several companies, where trainees in a first phase receive training in ICT and in a second phase enter into a professional internship, it allows easier their integration in companies with a need for staff in the programming areas. We emphasize that all trainees who attended these courses, during the year 2020-2021, are all already working in these companies, having signed an employment contract for 2 years and with a salary higher than the national minimum wage from Portugal.

In future work, the authors will improve the already developed methods of remote and hybrid work, mainly using the BL approach. According to Alqahtani *et al.* (2020), BL is one of the most popular and preferred e-learning models among teachers, professors, and students. In addition, more detailed surveys will also be conducted to collect students' opinions and reflections related to blended and hybrid learning approaches.

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