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Guidelines: Design and Advertise



e-VET4AI

e-VET Trainers 4 Artificial Intelligence

**Intellectual Output R3
Activity A4**

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Index

1. Introduction	3
2. What are the objectives of this guide?	3
Understanding the e-vet4ai Online Courses	3
Identifying Practical Teaching Opportunities:	3
Applying Theoretical Concepts in Practical Scenarios:	4
Encouraging Collaboration and Innovation:	4
Assessing Practical Learning Outcomes:	4
Conclusion:	4
3. What should teachers expect to learn in the e-VET4AI platform online courses”?	4
1.- Artificial Intelligence:	5
2.- Augmented Reality	6
3.- Big Data	7
4. Digital Twins	8
5. Machine Learning	10
4. How can you apply what you have learnt online in the classroom?	11
a.- Theoretical part	11
b.- Practical part	13
5. Practical Application: Challenges	15
a.- What is a challenge?	15
b.- General Characteristics of the Challenges	16
c.- How will these guidelines be used?	17
6. Why the collaborative Challenge-Based learning	18
7. How to create the Team	19
8. How to define the challenge	20
9. How to apply Collaborative Challenge Based Learning methodology in the classroom	22
0.- Activate the team	22
1.- Propose the challenge	23
2.- Identify and connect with the Challenge	23
3.- Set parameters	24
4.- Obtain and organise Information	25

5.- Generate alternatives	26
6.- Present the Proposals	26
7.- Select the Proposal	27
8.- Plan actions	28
9. Execute actions	28
10. Expose Results	29
11. Evaluation of results	30
10. Student assessment.	31
11. Challenge final evaluation	33
1. Time:	33
2. Resources:	33
3. The Challenge Itself:	33
4. Teachers Team:	33
5. Student Team:	33
Conclusion:	34
12. Frequently Asked Questions	35
ANEX 1: TEACHERS' TEMPLATE	37
ANEX 2: STUDENTS' TEMPLATE	42

1. Introduction

In an ever-changing environment with regular **workforce** changes, it's critical that **vocational training** evolves into Intelligent Vocational Training, prioritising **efficient learning** to meet current and future demands. Vocational training now goes beyond just creating skilled workers to developing **professionals with diverse skills**. As we anticipate future scenarios, we are committed to nurturing **talented professionals**.

We can't ignore the ongoing **digital transformation's impact on education**. The human factor is central to this shift, so we are focusing on fostering humanistic leadership in the upcoming workforce.

Dynamic professional training is crucial for managing these shifts, calling for a thorough change in learning models. In the **Learning and High Performance sphere**, we're creating learning strategies that include critical, constructive, and creative thinking. This is aimed at cultivating a new type of professional that possesses emotional, creative, and executive intelligence.

2. What are the objectives of this guide?

The e-vet4ai project has introduced online courses designed to equip teachers with the necessary **knowledge and skills related to artificial intelligence in vocational education and training**. While these courses effectively provide theoretical understanding, the challenge lies in **translating this knowledge into practical teaching for students**. This document aims to guide teachers in bridging this gap by offering strategies and recommendations for effectively applying the knowledge and skills acquired from the e-vet4ai online courses in their everyday classroom practices.

Understanding the e-vet4ai Online Courses

The first step is to provide a comprehensive overview of the e-vet4ai online courses. Teachers should familiarise themselves with the **course content, objectives, and learning outcomes**. This section will highlight the core concepts covered, including **artificial intelligence applications, ethics, and technical aspects of AI**. By gaining a deep understanding of the online courses, teachers can effectively leverage this knowledge in practical teaching scenarios.

Identifying Practical Teaching Opportunities:

This objective will focus on identifying opportunities to **integrate the acquired knowledge and skills into practical teaching**. Teachers should analyse their existing curriculum and identify areas where **AI-related topics** can be incorporated. This may involve adapting existing lessons or creating new ones that connect theoretical concepts with real-world applications.

Applying Theoretical Concepts in Practical Scenarios:

This objective will delve into specific strategies for applying theoretical concepts from the e-vet4ai online courses in practical scenarios. It will explore various **teaching methodologies and instructional techniques** that can effectively engage students and enhance their understanding of AI. Additionally, teachers will be guided on how to incorporate **hands-on activities, case studies, and projects** that allow students to directly apply their knowledge and skills in AI-related tasks.

Encouraging Collaboration and Innovation:

AI is a rapidly evolving field, and it is crucial to foster a culture of **collaboration and innovation** among students. This objective will emphasise the importance of collaborative learning and project-based activities that encourage students to work together, share ideas, and solve problems collectively.

Assessing Practical Learning Outcomes:

To ensure the effectiveness of the practical teaching approach, this objective will address **assessment strategies** tailored to evaluate students' practical learning outcomes. It will explore various formative and summative assessment methods that capture students' ability to apply AI knowledge and skills in real-world contexts.

Conclusion:

Translating knowledge and skills acquired from the e-vet4ai online courses into **practical teaching** is a significant endeavour for educators. This document has provided a comprehensive guide for teachers to bridge the gap between theory and practice. By understanding the online courses, identifying practical teaching opportunities, applying theoretical concepts in practical scenarios, leveraging technology and resources, fostering collaboration, and implementing effective assessment strategies, teachers can successfully integrate AI knowledge and skills into their everyday classroom practices. Through this holistic approach, students will not only gain theoretical knowledge but also develop practical competence in the exciting field of artificial intelligence.

3. What should teachers expect to learn in the e-VET4AI platform online courses?

This section describes the objectives of the **e-VET4AI project's online training**, designed to enhance VET teachers' knowledge and skills in AI and related fields within the metalworking industry. The carefully planned activities focus on topics like AI, Augmented Reality, Big Data, Digital Twin, and Machine Learning, providing a mix of theory and practical knowledge.

The intended **learning outcomes** measure the efficacy of these activities and define what learners should comprehend post-training. These outcomes, directly tied to the content and teaching strategies, and informed by trainee needs, also detail what skills and knowledge trainers

stand to gain. Understanding these outcomes can help trainers plan their learning journey and application of new skills in their teaching.

1.- Artificial Intelligence:

This video/course provides an in-depth overview of Artificial Intelligence (AI), a **ground-breaking technology** which has become more prominent recently. We will explain what AI is, its origins, its uses, and how it differentiates from related areas such as Machine Learning and Data Science. Essentially, AI is about creating systems that mimic human traits, from learning abilities to spatial awareness. We will investigate AI's various interpretations, its functions, its many uses, the opportunities it brings, and how businesses can leverage this radical tech. Here are the **expected Learning Results** of the e-vet4ai platform in the Artificial Intelligence area:

- **Milestones of Artificial Intelligence:** This section will explore the key historical developments that have shaped the field of AI. By examining notable milestones, we can gain insights into how AI has evolved over time.
- **Intelligent Machines or Knowledge Technologies:** Here, we will delve into the concept of intelligent machines and knowledge technologies, understanding how they relate to AI and contribute to its advancement.
- **The Definition of AI:** Defining AI is crucial to grasp its scope and significance. We will discuss different definitions of AI and establish a foundation for further exploration.
- **Definition of the Elements Contributing to the First Definition of AI:** Building upon the previous topic, this section will break down the elements that contribute to the initial definition of AI, providing a more detailed understanding of its components.
- **Technologies Enabling and Supporting Artificial Intelligence:** AI relies on various technologies that enable its functioning. We will explore these supporting technologies, such as natural language processing, computer vision, and robotics.
- **Applications of Artificial Intelligence:** This section will delve into the diverse applications of AI across different industries and sectors. From healthcare to finance, we will examine real-world use cases and understand the impact of AI in solving complex problems.
- **AI in Human Resources Management and Leadership:** Understanding the role of AI in human resources management and leadership is essential in the modern workplace. We will explore how AI is transforming these areas and discuss the implications and benefits it brings.
- **State of the Art of Artificial Intelligence Use:** Examining the current state of AI adoption, we will analyse how organisations are leveraging AI to drive innovation, improve efficiency, and gain a competitive edge.
- **The Skills Required by the Job Market and the New Professional Figures:** With the rise of AI, the job market is evolving. We will discuss the skills that are in high demand, the emergence of new professional roles, and the importance of upskilling in the AI era.
- **Artificial Intelligence Use Cases:** This section will provide specific examples of AI use cases across different industries. From autonomous vehicles to personalised marketing, we will showcase how AI is transforming various sectors.
- **Artificial Intelligence in the Factory... and Everywhere!:** AI is making its way into factory settings and impacting manufacturing processes. We will explore how AI is revolutionising the factory floor and discuss its broader integration into our daily lives.

- EU Regulation on Artificial Intelligence: As AI becomes increasingly pervasive, regulations play a crucial role. We will examine the European Union's regulatory framework on AI and its implications for businesses and individuals. Regulatory Sandboxes in the Design of the AI Act: Regulatory sandboxes provide a controlled environment for testing and implementing AI innovations. This section will explore the concept of regulatory sandboxes and their relevance in shaping AI policies.
- The Ethical Implications of the Use of AI and the Challenge of Responsibility: Ethics is a fundamental aspect of AI development and deployment. We will delve into the ethical implications surrounding AI adoption, including bias, privacy, and accountability.

2.- Augmented Reality

Augmented Reality (AR) is a technology that **adds digital details to our physical world**, using devices like smartphones, smart glasses, and interactive windows. Its potential applications are broad, impacting industries from manufacturing to smart packaging. AR can be classified into two types. The first is mobile AR, which uses features of smartphones and tablets like the camera and GPS to overlay digital information onto the physical world. The second type employs computer software that recognizes certain markers to create multimedia content. Here are the **expected learning outcomes** from the e-vet4ai platform in the Augmented Reality area:

- Augmented Reality Definition: Understanding the concept and fundamental principles of Augmented Reality, exploring its capabilities and potential applications.
- Augmented Reality Timeline: Tracing the evolution of Augmented Reality technology and its key milestones from inception to the present day.
- Virtual Reality vs. Augmented Reality: Comparing and contrasting Augmented Reality with Virtual Reality, highlighting their similarities, differences, and respective use cases.
- Reality-Virtuality Continuum: Exploring the continuum that encompasses the spectrum of mixed reality experiences, ranging from fully physical reality to fully virtual reality, with Augmented Reality falling in between.
- Augmented Reality Principles and Evidences: Examining the underlying principles and technological foundations of Augmented Reality, including computer vision, sensor fusion, and spatial mapping. Understanding the evidence and algorithms used to create seamless AR experiences.
- Augmented Reality as a Marketing Tool: Investigating how Augmented Reality is used as a powerful marketing tool. Exploring successful AR marketing campaigns and understanding how businesses leverage AR to enhance customer engagement and brand experiences.
- Challenges in Implementing AR Tools: Identifying the challenges and considerations involved in implementing AR tools and applications. Discussing technical limitations, user experience design, privacy concerns, and ethical considerations.
- Enabling Technologies: Exploring the enabling technologies that drive Augmented Reality, such as display technologies, motion capture technologies, and software development kits (SDKs).
- Display Technologies: Examining the different display technologies used in Augmented Reality, including optical see-through displays, video see-through displays, and projection-based displays.

- Motion Capture Technologies: Understanding motion capture technologies used in AR, such as marker-based and markerless tracking systems, and exploring their role in accurately tracking and interacting with virtual objects in real-time.
- Programming Tools SDK - Software Development Kit: Introducing the programming tools and SDKs available for building Augmented Reality applications. Understanding their features, capabilities, and development workflows.
- Programming Tools SDK - Examples: Exploring real-world examples and case studies of Augmented Reality applications built using different SDKs. Analysing the development process and learning from successful AR projects.
- Augmented Reality and its Applications within the Industry: Investigating how Augmented Reality is applied across various industries, such as healthcare, retail, education, and entertainment. Exploring use cases, benefits, and challenges in implementing AR solutions within different sectors.

By covering these topics, the e-vet4ai platform aims to provide learners with a comprehensive understanding of Augmented Reality, its underlying technologies, and its wide-ranging applications. Learners will gain insights into the principles and challenges of AR implementation, explore enabling technologies, and examine real-world examples of AR in various industries.

3.- Big Data

Big Data has become a crucial aspect of our everyday lives, shaping the way we live, work, and interact with the world around us. The e-vet4ai platform aims to provide a comprehensive introduction to Big Data, exploring its significance, characteristics, and applications. But **why is Big Data so important for our everyday lives?**

Data, in its raw form, is like a continuous sequence of symbols. To extract value from data, it **must be transformed into meaningful information** that is organised and contextualised for users to comprehend. Big Data plays a pivotal role in this process by enabling the collection, storage, processing, and analysis of vast volumes of data from diverse sources. Here's a glimpse of the expected learning outcomes in the Big Data area:

- What is Big Data?: Understanding the concept of Big Data and its defining characteristics, including volume, velocity, and variety. Exploring the challenges and opportunities associated with handling large and complex datasets.
- Big Data 3 "Vs": Delving into the three essential aspects of Big Data - volume, velocity, and variety. Understanding how these factors contribute to the complexity and value of Big Data.
- Big Data Examples: Examining real-world examples of Big Data applications across various domains, such as healthcare, finance, transportation, and social media. Understanding how Big Data is driving innovation and transforming industries.
- Big Data Life Cycle: Exploring the life cycle of Big Data, including data collection, storage, processing, analysis, and visualisation. Understanding the key stages and best practices in managing and leveraging Big Data effectively.

- **Big Data Analytics:** Introducing the field of Big Data analytics and its methodologies, including descriptive, diagnostic, predictive, and prescriptive analytics. Understanding how data-driven insights and patterns can be derived from Big Data.
- **Data Analyst Vs. Data Scientist:** Differentiating between the roles of a data analyst and a data scientist. Understanding their skill sets, responsibilities, and the importance of their contributions in extracting value from Big Data.
- **Traditional Approach Vs. Big Data approach:** Contrasting the traditional approach of data processing with the Big Data approach. Exploring the benefits and limitations of each approach and understanding why Big Data technologies have become essential in today's data-driven world.
- **Big Data Solutions:** Exploring the various tools, technologies, and frameworks used to handle Big Data, such as Hadoop, Apache Spark, and NoSQL databases. Understanding how these solutions address the challenges posed by Big Data.
- **Big Data Platforms:** Introducing popular Big Data platforms and ecosystems, such as Apache Hadoop and Apache Kafka. Understanding their architecture, components, and how they enable scalable and distributed data processing.
- **Big Data Potentialities and Risks:** Assessing the potential benefits and risks associated with Big Data. Understanding the ethical, privacy, and security considerations when dealing with large-scale data.
- **Numbers:** Exploring the staggering numbers associated with Big Data, such as the amount of data generated daily, the growth rate of data, and the economic impact of Big Data
- **Some Interesting Considerations:** Examining thought-provoking aspects of Big Data, such as data-driven decision-making, data monetization, and the societal impact of Big Data technologies.

By covering these topics, the e-vet4ai platform aims to equip learners with a solid understanding of Big Data's importance, characteristics, and potential applications. Learners will gain insights into the various stages of the **Big Data life cycle**, the role of analytics in extracting value from data, and the challenges and opportunities presented by Big Data.

4. Digital Twins

The concept of the digital twin has gained significant attention and importance in recent years. It refers to the creation of a **virtual counterpart or replica of a physical system** or process. This virtual replica, known as a digital twin, allows for optimization, analysis, and prediction of the performance of its physical counterpart.

The e-vet4ai platform aims to provide comprehensive learning in the field of digital twins, covering various aspects and topics. The expected learning outcomes of the platform in the Digital Twin area include:

- **Definition of Digital Twin:** Understanding the fundamental concept of a digital twin and its purpose in bridging the gap between the digital and physical worlds.
- **Digital Twin trend evolution:** Exploring the historical development and evolution of digital twin technology, including its advancements over time.

- Timeline of Digital Twin: Examining the key milestones and significant events in the timeline of digital twin technology, highlighting its impact on industries.
- Characteristics of the Digital Twin: Identifying the key features and characteristics that define a digital twin, such as real-time updating, data integration, and predictive capabilities.
- Digital Twin types: Exploring different types and variations of digital twins, including product twins, process twins, and system twins, understanding their specific applications and benefits.
- Digital Twin and data scientist: Understanding the role of data scientists in the implementation and utilisation of digital twins, including data collection, analysis, and modelling.
- Digital Twin in the factory: Examining the application of digital twins in the factory setting, including their role in optimising manufacturing processes, improving productivity, and enhancing maintenance procedures.
- Human Supervision in Digital Twin: Exploring the importance of human supervision and intervention in the operation and management of digital twins, ensuring effective decision-making and control.
- Human Supervision in DT synthesis and execution phase: Understanding the role of human supervision during the synthesis and execution phases of digital twin operations, including data interpretation, validation, and decision-making.
- Examples of DT platforms: Exploring various digital twin platforms, such as Eclipse Ditto, Bosch IoT Things, AWS IoT Device Shadow Service, and Azure Digital Twins, understanding their features and functionalities.
- Architecture of Digital Twin: Examining the architectural framework and components of a digital twin system, including data integration, analytics, visualisation, and communication.
- Digital Twin in the new technology network: Exploring the integration of digital twins into emerging technology networks, such as the Internet of Things (IoT) and cloud computing, and their implications for data sharing and connectivity.
- Digital Twin in the new technology network - DATA property: Understanding the importance of data property and ownership in the context of digital twins within the new technology network.
- Digital Twin in the new technology network - the case of cybersecurity: Exploring the challenges and considerations related to cybersecurity in the context of digital twin implementation and operation.
- Digital Twin and education sector: Investigating the potential applications of digital twins in the education sector, such as virtual laboratories and simulation-based learning.
- Digital Twin for health: Examining the role of digital twins in the healthcare industry, including personalised medicine, remote patient monitoring, and predictive healthcare analytics.
- How Digital Twins Simplify the IoT: Understanding how digital twins simplify and enhance the Internet of Things (IoT) ecosystem through data integration, predictive analytics, and optimization.
- Examples in transportation: Exploring practical examples of digital twins in the transportation industry, such as predictive maintenance for vehicles and optimising logistics and supply chain operations.

- Examples of application - Aerospace: Examining the application of digital twins in the aerospace industry, including aircraft design, maintenance, and performance optimization.
- Examples of application - Architecture and construction sector: Investigating how digital twins are used in the architecture and construction sector, facilitating design visualisation, monitoring construction progress, and optimising building performance.
- Examples of applications - Automotive: Exploring practical applications of digital twins in the automotive industry, including vehicle design, manufacturing process optimization, and predictive maintenance.

Through the comprehensive coverage of these topics and examples, the e-vet4ai platform aims to provide learners with a solid foundation and practical understanding of digital twin technology and its diverse applications across various industries.

5. Machine Learning

Machine Learning has emerged as a powerful field within the realm of artificial intelligence, revolutionising various industries and sectors. The e-vet4ai platform aims to provide comprehensive learning in Machine Learning, covering essential concepts, approaches, and applications. The expected learning outcomes in the Machine Learning area include:

- The Machine Learning: Understanding the fundamental principles and concepts of Machine Learning, including its definition, key components, and its role in data-driven decision-making
- Defining Machine Learning approaches: Exploring different approaches and techniques in Machine Learning, such as supervised learning, unsupervised learning, reinforcement learning, and deep learning. Understanding the strengths and limitations of each approach and their applications.
- The skills required by the job market and the new professional figures: Identifying the skills and competencies demanded by the job market in the field of Machine Learning. Exploring the emerging roles and professional figures associated with Machine Learning, such as data scientists, machine learning engineers, and AI researchers.
- Sectors of application - Industry: Examining the application of Machine Learning in the Industrial sector. Understanding how Machine Learning algorithms can optimise manufacturing processes, improve quality control, and enhance predictive maintenance.
- Sectors of application - Logistics: Investigating the use of Machine Learning in the logistics industry. Exploring how Machine Learning can optimise supply chain management, demand forecasting, route optimization, and inventory management.
- Sectors of application - Image recognition: Exploring the application of Machine Learning in image recognition tasks. Understanding how Machine Learning models can be trained to classify and identify objects, recognize patterns, and perform image-based analysis in various fields, such as medical imaging and autonomous vehicles.
- Sectors of application - Text generation, translation, and analysis: Examining the role of Machine Learning in natural language processing tasks. Exploring how Machine Learning algorithms can generate text, perform machine translation, sentiment analysis, and text

summarization, enabling advancements in chatbots, language understanding, and content analysis.

By covering these topics, the e-vet4ai platform aims to equip learners with a solid foundation in Machine Learning, enabling them to understand the principles, applications, and implications of this transformative field. Learners will gain valuable insights into the skills needed for the job market and the diverse sectors where Machine Learning is making a significant impact.

4. How can you apply what you have learnt online in the classroom?

a.- Theoretical part

Proposal: Application of Theoretical Contents from e-VET4AI Online Courses in Classroom Settings using Training Pills.

Objective: Demonstrate how the theoretical content learned in the e-VET4AI training model, focusing on Artificial Intelligence (AI) and Data Analytics, can be effectively applied in the classroom using Training Pills. These Training Pills are short, focused learning sessions designed to deliver targeted knowledge and practical skills to students.

Implementation Steps:

1. **Identify Key Concepts:** Identify the key concepts and theoretical content from the e-VET4AI training model that are most relevant to the classroom setting. These concepts could include AI fundamentals, data analytics techniques, application of AI in different industries, ethical considerations, and emerging trends in the field.
2. **Design Training Pills:** Break down the identified key concepts into smaller, digestible units suitable for Training Pills. Each Training Pill should focus on one specific concept or skill and provide a concise overview, examples, and practical exercises for students to apply their learning.
3. **Interactive Presentations:** Create interactive presentations for each Training Pill. Use multimedia elements such as videos, graphics, and interactive quizzes included in the platform, to engage students and enhance their understanding of the content.
4. **Hands-on Activities:** Connecting the training pills, include hands-on activities in each Training Pill to allow students to practise and apply the theoretical concepts. These activities can involve working with datasets, using AI tools or software, analysing case studies, or engaging in problem-solving exercises. Provide clear instructions and guidelines to support students' independent learning.
5. **Assessments and Feedback:** Design assessments to evaluate students' understanding and application of the theoretical concepts covered in the Training Pills. These assessments can include quizzes, practical assignments, or group projects. Provide

timely and constructive feedback to guide students' progress and address any misconceptions.

6. **Integration with Curriculum:** Align the Training Pills with the existing curriculum to ensure they complement and enhance the classroom learning experience. Identify specific topics or units where the Training Pills can be integrated effectively, and map the content accordingly. Collaborate with subject teachers to integrate the Training Pills seamlessly into their teaching plans.
7. **Flexible Delivery Options:** Offer flexible delivery options for the Training Pills to accommodate different learning preferences and circumstances. Consider providing access to the Training Pills through an online learning platform or a designated classroom workstation. Additionally, allow students to review the Training Pills at their own pace to reinforce their understanding and revisit the content as needed.
8. **Ongoing Support:** Provide ongoing support to students throughout their engagement with the Training Pills. Offer opportunities for students to seek clarification, ask questions, and engage in discussions related to the content. Encourage collaboration among students by facilitating peer-to-peer learning and sharing of insights and experiences.

Benefits of Training Pills:

1. **Time-Efficient:** Training Pills provide targeted and focused learning experiences that can be completed within shorter time frames, allowing for efficient knowledge acquisition.
2. **Practical Application:** The hands-on activities included in the Training Pills enable students to apply the theoretical concepts in real-world scenarios, enhancing their practical skills and understanding.
3. **Customization:** Training Pills can be tailored to meet the specific needs and learning objectives of the classroom, ensuring relevance and applicability to the students' academic journey.
4. **Independent Learning:** Training Pills promote self-directed learning as students can access the content independently, at their own pace, and revisit the materials as needed.
5. **Engagement and Motivation:** The interactive nature of Training Pills, with multimedia elements and practical exercises, enhances student engagement and motivation, making the learning experience more enjoyable and impactful.

Reference materials: When it comes to applying theoretical content on collaborative challenge-based learning in the classroom, there are various resources available that can provide practical guidance. Here are some reference materials that can help you understand how to apply the methodology effectively:

- "<https://ethazi.tknika.eus/es/>" Tknika's web page: The Basque VET applied Research Center and its way to innovation, into its area of Learning and high performance, boasts content about transforming classical classroom methods into Collaborative Challenge

Based Learning. It also includes information about how to use training pills to work on theoretical contents with students.

- "Challenge-Based Learning in the Classroom: A Guide to Using Training Pills" by Aaron Eylar and Valinda Kimmel: This book focuses specifically on using training pills, which are short, focused learning experiences, to implement challenge-based learning in the classroom. It provides step-by-step instructions, examples, and case studies.
- "Project-Based Learning Handbook: A Guide to Standards-Focused Project-Based Learning for Middle and High School Teachers" by Thom Markham: Although not solely focused on collaborative challenge-based learning, this handbook offers practical advice and strategies for implementing project-based learning in the classroom, which can be adapted to a collaborative challenge-based approach.
- "Collaborative Learning Techniques: A Handbook for College Faculty" by Elizabeth F. Barkley, Claire H. Major, and K. Patricia Cross: While primarily aimed at higher education, this book provides a wealth of techniques and strategies for promoting collaborative learning. Many of these techniques can be applied in K-12 classrooms as well.
- Online resources and platforms: Explore websites and platforms such as Edutopia (www.edutopia.org) and the Buck Institute for Education (www.bie.org) that offer practical resources, lesson plans, and examples of collaborative project-based learning. These resources often include guidance on designing and implementing collaborative challenges.
- Professional development workshops and conferences: Look for professional development opportunities focused on project-based learning, challenge-based learning, and collaborative learning. These events often provide hands-on training and practical strategies for applying these methodologies in the classroom.
- Education blogs and communities: Engage with online communities of educators who are implementing collaborative challenge-based learning. Follow education blogs, join social media groups, and participate in discussions to learn from experienced practitioners and gain practical insights.

By implementing Training Pills in the classroom, students will have access to targeted theoretical content from the e-VET4AI training model in a concise and practical format. This approach will enable them to acquire and apply AI and Machine Learning and all the theoretical contents included in the e-VET4AI platform.

b.- Practical part

Proposal: Application of Theoretical Contents from e-VET4AI Online Courses in Classroom Settings using Challenge Based Learning Methodology

Objective: The objective of this proposal is to demonstrate how the theoretical content learned in the e-VET4AI training model, focusing on Artificial Intelligence (AI) and Data Analytics, can be effectively applied in the classroom with students using the Challenge Based Learning (CBL) methodology. This approach aims to engage students, promote critical thinking, and develop practical skills related to AI and Data Analytics.

Implementation Steps:

1. **Introduction to Artificial Intelligence:** Challenge: Design an AI-powered solution to address a specific real-world problem. Description: Introduce students to the concept of AI and its applications. Present them with a challenge relevant to their field of study, such as optimising energy consumption, enhancing manufacturing processes, or improving healthcare outcomes. Students will work in teams to research, design, and implement AI algorithms or systems to solve the identified problem. They will explore different AI techniques, assess the impact, and present their findings to the class.
2. **Introduction to Augmented Reality:** Challenge: Create an augmented reality experience to enhance learning in a specific subject. Description: Familiarise students with Augmented Reality (AR) technology and its potential in education. Assign each team a subject or topic from the curriculum and challenge them to develop an AR-based learning experience. Students will research AR tools, design interactive elements, and create virtual simulations or visualisations that enhance understanding and engagement. They will present their AR projects, explaining how they facilitate learning in the chosen subject.
3. **Introduction to Big Data:** Challenge: Analyse real-world datasets to derive insights and make data-driven decisions. Description: Introduce students to the importance of Big Data in various domains. Provide them with relevant datasets or access to publicly available data sources. Students will explore data analysis techniques, visualise data patterns, and extract meaningful insights. They will identify trends, correlations, or predictive patterns, enabling them to make data-driven decisions. Students will present their findings and discuss the implications of data analysis in their respective fields.
4. **Introduction to Digital Twin:** Challenge: Develop a digital twin model for a mechanical system to optimise performance. Description: Introduce the concept of Digital Twin and its applications in the mechanical domain. Assign teams to choose a mechanical system and develop a digital twin model. Students will collect relevant data, create virtual replicas, and simulate different operating scenarios. They will analyse performance metrics, identify areas for improvement, and propose optimization strategies based on their digital twin models. Students will present their findings and demonstrate the potential benefits of digital twin technology.
5. **Introduction to Machine Learning:** Challenge: Train a machine learning model to solve a specific problem. Description: Teach students the fundamentals of machine learning and its practical applications. Assign teams to identify a problem within their field of study that can be addressed using machine learning. Students will gather relevant data, preprocess it, and train machine learning models to make predictions or classifications. They will evaluate model performance, fine-tune parameters, and present their results along with insights gained from the process.

Support and Assessment:

1. Provide guidance and resources to students throughout the challenges, including access to e-VET4AI training materials and additional learning materials.

2. Facilitate collaborative discussions and encourage teamwork among students to foster peer learning and problem-solving.
3. Regularly assess student progress through presentations, reports, and demonstrations.
4. Offer feedback and constructive criticism to guide students' learning and improvement.
5. Encourage reflection and documentation of the learning process, allowing students to articulate their understanding and lessons learned.

By implementing the Challenge Based Learning methodology in the classroom, students will actively engage with the theoretical content from the e-VET4AI online courses. This approach will enable them to apply their knowledge in real-world scenarios.

5. Practical Application: Challenges¹

a.- What is a challenge?

Challenge-based Collaborative Learning is a teaching approach that **transforms problematic situations into educational challenges**, engaging students in teamwork to solve them. This active learning promotes both technical and broad skills, with students owning their learning journey and innovatively generating knowledge.

The method **intertwines academic outcomes with real-world problems**, encouraging practical application of knowledge and skills. It fosters critical thinking, problem-solving abilities, and exploration of multiple viewpoints. The collaborative process includes information gathering, analysis, synthesis, and decision-making, leading to the creation and presentation of proposals.

Continuous evaluation and feedback are integral, allowing students to reflect and enhance their skills. This method supports the adaptation of learning environments to encourage active, cooperative, and flexible work.

Employing this approach, students not only build technical prowess but also essential skills like communication, teamwork, independence, and social awareness. It advocates a learner-centred approach, boosting creativity, engagement, and the acquisition of transferable skills.

In essence, Challenge-based Collaborative Learning is a **dynamic, interactive educational experience**. It empowers students to take charge of their education, equipping them with the necessary skills and knowledge to tackle complex problems and excel in their fields.

¹ More information: <https://www.youtube.com/watch?v=yoEXhnKJ0qg>

b.- General Characteristics of the Challenges

This model turns issues into challenges, guiding the learning process until objectives are met. It develops **both technical skills** (knowledge from various subjects) and **cross-cutting abilities** (autonomy, teamwork, etc.). In this model, classroom teams collaboratively tackle problems, gaining knowledge to offer optimal solutions. Students lead their own learning in a challenge-based scenario, individually or in teams, taking action and producing results. These results are analysed to determine what worked and what didn't, informing future strategies to achieve greater goals.

Some characteristics of this model include:

- **Teamwork**
- **Intermodularity:** Taking into account the professional competencies and learning outcomes addressed in each challenge or problematic situation that affect more than one subject or professional module.
- **Collaboration among teaching teams:** Teamwork starts here, as each responsible teacher of a module or subject needs to assess the suitability of the challenge to address specific learning outcomes, plan schedules, spaces, moments, and mentoring methods for students.
- **Evaluation as a key element:** It involves constant evaluation integrated into the process, providing frequent feedback to students on their progress in acquiring professional competencies.
- **Adaptation of learning spaces:** This methodology requires flexible, open, and interconnected classrooms, equipment, and spaces that allow for active and collaborative work.

The process of solving a challenge is approached by following the following 11 steps:

- 1) Propose the challenge.
- 2) Identify and connect with the challenge.
- 3) Set parameters.
- 4) Obtain and organise information.
- 5) Generate alternatives.
- 6) Present the proposals.
- 7) Select the proposal.
- 8) Plan actions.
- 9) Execute actions.
- 10) Expose results.
- 11) Evaluate results.

c.- How will these guidelines be used?

The aim of the micro design is to outline a **comprehensive guide for teachers** on how to create challenges using the Collaborative Learning Based on Challenges methodology. The guide will provide a detailed description of each phase, along with examples and instructions. Additionally, it is proposed to incorporate a Word template that complements the guide, allowing teachers to easily structure and document their challenges.

Components of the Guide:

- Overview of Collaborative Learning Based on Challenges: This section will provide a brief introduction to the methodology, explaining its principles and benefits in fostering student engagement and critical thinking.
- Phases of Challenge Creation: A detailed description of each phase involved in creating a challenge will be provided. This includes:
 - Defining the Challenge: Teachers will learn how to formulate a clear and concise challenge statement, ensuring it aligns with the learning objectives and student interests.
 - Setting Parameters: Guidance will be provided on defining the scope, resources, and constraints of the challenge, allowing teachers to establish realistic boundaries for students.
 - Gathering Information: Instructions on how to research and collect relevant information for the challenge will be included, along with tips for organising the gathered data effectively.
 - Generating Alternatives: Teachers will be guided on how to encourage students to brainstorm and develop multiple possible solutions or approaches to the challenge.
 - Presenting Proposals: Strategies for students to communicate and present their proposed solutions or alternatives will be outlined, promoting effective communication and critical evaluation.
 - Selecting the Solution: Guidance will be provided on how to facilitate the process of selecting the most viable solution, ensuring students engage in thoughtful decision-making.
 - Planning and Execution: Teachers will learn how to guide students in creating a plan of action and executing the chosen solution, fostering project management skills.
 - Results Exhibition: Instructions on how to facilitate a platform or event where students can showcase and share their results with peers, teachers, and the wider community.
 - Evaluation and Reflection: Teachers will be guided on how to assess student performance and provide constructive feedback, while also encouraging students to reflect on their learning journey.

Word Template Integration: The micro design guide will be accompanied by a user-friendly Word template that aligns with the recommended structure and format. The template will include designated sections for each phase of challenge creation, allowing teachers to easily fill in the required information and document their challenges efficiently.

6. Why the collaborative Challenge-Based learning

Cooperation entails working in collaboration, providing assistance, advocating for one another, demonstrating mutual interest, and attentively considering the needs of team members to attain shared objectives. Success is pursued not only for individual gain but for the collective benefit of all team members. Indeed, it is acknowledged that each person possesses unique strengths, and no individual possesses expertise in all areas.

The rationale for embracing collaborative learning includes the following:

1. **Development of Interpersonal Intelligence:** Collaborative learning fosters the growth of interpersonal intelligence among students. It establishes a learning community where all students engage in shared learning experiences, contributing to the enrichment and expansion of knowledge for each participant.
2. **Cultivation of Solidarity and Mutual Support:** Collaborative learning facilitates the formation of partnerships, cultivating solidarity, mutual support, and generosity among students. Initial collaborations evolve into enduring affective bonds, fostering an environment where students become committed individuals capable of enhancing the lives of others.
3. **Empowering Students as Active Learners:** By emphasising cognitive development, learning strategies, and making students active participants in their learning process, collaborative learning promotes the acquisition of essential skills, nurturing students' ability to learn independently and effectively.
4. **Enhanced Motivation and Engagement:** Collaborative learning boosts motivation by instilling in students a sense of purpose and significance in pursuing academic goals that they perceive as important and valuable. Consequently, students exhibit heightened effort and dedication towards their learning objectives.
5. **Meaningful and Enjoyable Learning Experiences:** Through collaborative learning, both teachers and students find greater meaning in the learning process. They become actively engaged and invested in school sessions, resulting in a more enjoyable and fulfilling educational journey.

As a result, students assume the role of protagonists in the classroom, creating a transformative learning environment. Progress is achieved through the completion of activities (challenges), subsequent evaluations, and the commitments made by each student to advance their individual learning journeys.

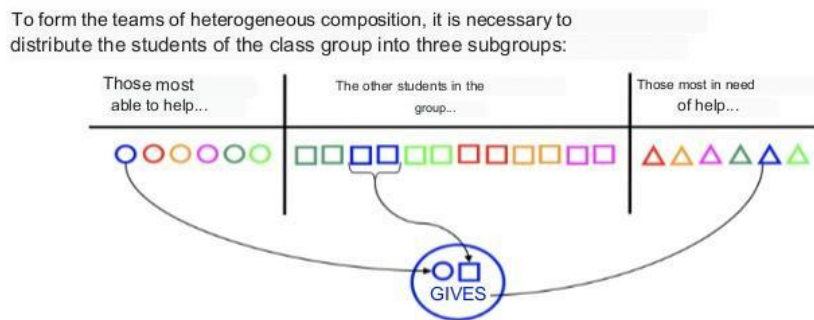
7. How to create the Team

Within this context, we present a range of methodologies for establishing groups within the physical space of the classroom. The objective is to form distinct groups, each responsible for creating its own contractual agreement. Within these group contracts, participants will collaboratively outline the commitments they intend to uphold throughout their shared journey.

These group contracts will undergo gradual development, transformation, and refinement as a direct outcome of the group's collective experiences and reflective processes.

The establishment of cooperative learning teams holds paramount importance within the structure of collaborative activities. It serves as a critical component of this educational approach.

Typically, cooperative learning teams consist of four to five students, with a preference for heterogeneity in their composition. This heterogeneity encompasses factors such as gender, ethnicity, interests, abilities, motivation, performance, and autonomy. The aim is for each team to reflect the diverse characteristics of the whole class group. To achieve this, it is desirable for one student to exhibit a high level of capacity, performance, autonomy, and motivation in comparison to the group, while two students possess a moderate level, and another student showcases a lower level.



To ensure the desired heterogeneity², the teaching team often distributes participants across different teams, taking into account their preferences and possible incompatibilities. Conducting a sociometric test can be beneficial in acquiring relevant information for this purpose.

Alternatively, a simpler approach involves asking participants to identify three preferred partners for collaboration during program sessions. This aids in identifying those who have received fewer selections or have not been chosen. Careful consideration is then given to incorporating them into a team where at least one chosen individual is willing, under the guidance of the teacher, to provide assistance and support to help them integrate within the team.

A common method for forming stable base teams, which remain intact for a significant duration, typically a school year, follows this process: Students are divided into three columns. One-quarter of the students are placed in the end column (equal to the desired number of teams of four

² Pere Pujolàs and José Ramón Lago (Coordinators). THE CA/AC PROGRAM (“Cooperate to Learn / Learn to Cooperate”) TO TEACH LEARNING AS A TEAM: Implementation of cooperative learning in the classroom. University of Vic.

Pere Pujolàs and José Ramón Lago (2018). Learn in cooperative learning teams. The CA/AC Program (“Cooperate to learn/Learn to cooperate”). Barcelona: Octaedro.

students, obtained by dividing the total number of participants by four). Priority is given to those capable of providing assistance, not necessarily based solely on academic performance but also on motivation, the ability to inspire and encourage others, and foster team dynamics. The quarter of students requiring more support, exhibiting less autonomy and motivation, is placed in the opposite end column. The remaining two quarters (half of the group) are placed in the middle column. Each team is then formed by selecting one student from the first column, two from the middle column, and one from the third column, while striving to maintain a balance across other variables such as gender and ethnicity.

In this arrangement, the group is divided into teams with heterogeneous compositions, which is particularly beneficial when learning something new. The teacher imparts knowledge, and during the execution of proposed activities, each team benefits from the presence of a more capable and motivated student who can explain and facilitate comprehension for the rest of the team. However, as students' progress and gain varying levels of understanding, it becomes advantageous for the same class group to occasionally work in teams with more homogeneous compositions. In such cases, teams can engage in exercises or activities with greater autonomy, tailored to their competence levels, while teachers have the opportunity to provide more personalised attention to sporadically formed teams, reinforcing or reviewing their learning or introducing new concepts to more advanced students.

When the organisation of the class into heterogeneous learning teams becomes stable, these teams are referred to as base teams, forming the fundamental grouping of students within the class. These established base teams play a crucial role when moving towards Intervention Area C, where explicit and systematic teaching of teamwork is intended. Four to five individuals within a team will have limited opportunities to develop effective teamwork skills unless they consistently work together, confronting and overcoming challenges that arise.

8. How to define the challenge

Challenges serve as opportunities for students to enhance their learning by engaging with real-world problems. These situations should closely mirror the realities of professional work, making the involvement of companies in the environment a vital factor in crafting these challenges. Collaborating with companies adds a significant level of authenticity to the problems that student groups will tackle and the subsequent presentation of their results. This partnership contributes to a more realistic and meaningful learning experience, as it aligns the challenges with actual industry scenarios.

In order for challenges to truly engage students, they must cultivate a distinct dynamic of problem-solving within the classroom. This dynamic should encompass a "divergence-convergence" process, encouraging students to explore multiple perspectives and generate diverse proposals. This approach necessitates the development of fundamental skills such as interpretation, communication, synthesis, and decision-making. By fostering this dynamic, students are empowered to actively participate in the learning process and cultivate essential competencies that extend beyond mere content acquisition.

The challenge is characterised by five key features:

1. **ACTIVE-COLLABORATIVE** experience: The emphasis is on fostering rich interactions among individuals, be it in solving challenges or in honing skills. The challenges are tackled collaboratively within groups, involving both students and teachers. This approach is dedicated to placing the focus of learning on students, encouraging their conscious and autonomous learning through active methodologies and hands-on experiences. Students take centre stage as the main protagonists of their own learning journey.
2. **CREATIVE** process: The challenge unfolds through a creative process, stimulating students to think innovatively, explore new possibilities, and generate unique solutions. This encourages them to tap into their creative potential, fostering imagination, problem-solving abilities, and the capacity to think outside the box.
3. **Real-life, SOCIAL REALITY** focus: The challenge centres around a situation that closely mirrors real-world work and social contexts. By aligning the challenge with actual realities, students gain a deeper understanding of the practical application of their knowledge and skills. This connection to the wider social reality enhances the relevance and authenticity of the learning experience.
4. **VIVID** proposition: The challenge is presented in a vibrant and engaging manner, capturing the attention and interest of students. It is designed to evoke curiosity, excitement, and a sense of relevance, ensuring that students are motivated to actively participate and invest their energy into the learning process.
5. **Learning tool and MEDIUM**: The challenge serves as a powerful tool for learning, functioning as a medium through which students acquire new knowledge, develop essential skills, and deepen their understanding of concepts. It is through the challenge that students actively engage with the learning materials, apply critical thinking, and make connections between theory and practice, resulting in a holistic and transformative learning experience.

9. How to apply Collaborative Challenge Based Learning methodology in the classroom

In order to apply the collaborative Challenge-Based Learning methodology in the classroom we propose to follow these next 11 steps. You can follow all of them or if you lack time you can also skip some of them if you need to.

0.- Activate the team

The objective of this phase is to establish and strengthen the context of collaborative learning. Initially, the groups are formed and activated as learning units. This involves creating spaces of trust and accountability, where individual expectations of each group member serve as a basis for determining operational and organisational dynamics. The purpose is to reach consensus on common group commitments.

During this phase, each group will periodically assess the extent to which these commitments are being fulfilled and identify areas for operational improvement.

IDEAS FOR THE TEACHING TEAM

- *To establish a collaborative learning context, the teaching team will focus on creating safe and trusting environments. They will intentionally design working groups, making decisions that directly impact relationships and learning outcomes throughout the challenge. This includes determining the group size, criteria for group formation, role distribution, and the duration of the groups' work both within the challenge and throughout the school year.*
- *To activate the collaborative context, the teaching team will prepare the groups for action by suggesting relevant dynamics, whether directly related to the challenge or not. If the teams have never worked together before, this warm-up phase can help them establish operating guidelines, agree on commitments, and build consensus. For teams that have already been formed, it provides an opportunity to review and update their guidelines, incorporating self-proposed improvements in teamwork skills if deemed essential for their professional development and profile.*

IDEAS FOR STUDENT GROUPS

- *Your team will serve as your primary workspace and unit, where the contributions of each member, along with consensus and shared responsibility, will foster the construction of new knowledge.*
- *If this is the first time your team is working together, it is an opportunity to initiate the process of getting acquainted and establishing a trusting atmosphere. This will facilitate reaching agreements on operational rules that consider the needs of all team members. It is the moment to implement your commitments and adopt behaviours that enhance your effectiveness, while also letting go of any practices that hinder your potential.*
- *For teams that are already familiar with each other, now is an ideal time to conduct a comprehensive review and update of your team contracts.*

1.- Propose the challenge

The purpose of this phase is to introduce and present the teams with a problematic situation that they will need to resolve.

IDEAS FOR THE TEACHING TEAM

- *The teaching team should aim to present the situation in an engaging manner, capturing the teams' attention and sparking surprise and curiosity. This is an opportune moment to provide students with the necessary information to commence the challenge, including details about time constraints, available resources, the methodology of work, evaluation criteria, and tools. It is also important to offer evidence and establish feedback moments.*

IDEAS FOR STUDENT GROUPS

- *Let the performance begin! Listen attentively and pay close attention to the subtleties conveyed through both verbal and non-verbal communication. Remember, clarity does not always guarantee correctness.*

2.- Identify and connect with the Challenge

This step facilitates a comprehensive comprehension of the situation confronting the teams, ensuring that everyone is on the same page. Moreover, it is an opportune moment for students to understand the available time, resources, evaluation criteria, and scheduled feedback sessions necessary to achieve the proposed learning objectives. They are encouraged to contemplate what they possess and how they can showcase their abilities.

Make Connections: What makes the challenge appealing to the team?

Through this step, the groups discover the significance and motivational aspects of the challenge, which are aligned with their interests. They aspire to take responsibility for overcoming this challenge. Consequently, it is crucial to establish consensus on the desired outcome that the group aims to achieve.

IDEAS FOR THE TEACHING TEAM

- *During this phase, the teaching team's role is to ensure that the students have a clear understanding of the challenge and possess all the requisite information to embark on it successfully. This includes providing details about the allocated time, available resources, the methodology of work, evaluation criteria, tools, delivery of evidence, and feedback moments. Typically, this information is communicated through the challenge statement or guidelines.*

3.- Set parameters

What information do we currently possess, and what do we need to acquire to confront this challenge?

The objective of this phase is to stimulate students by delineating the areas of knowledge that require exploration. It involves posing thought-provoking questions that guide their research. The aim is to encourage students to transition from what they already know to identifying what they still need to learn. It entails progressing from a state of "knowing what is missing" to "recognizing what I do not know." This process applies to both indirect skills and technical competencies.

The questions raised during this phase pertain to meaningful learning challenges and are designed to align with the chosen approaches.

IDEAS FOR THE TEACHING TEAM

- *The parameters refer to the guiding questions that steer students towards specific areas of knowledge (work areas) within the divided challenge. These questions prompt research and facilitate the development of the planned skills.*
- *In the teacher challenge, the teaching team will predefine the knowledge parameters or planned areas for the challenge. Students will then need to raise these parameters as questions. While there is no ideal number of parameters in a problem, it is important to note that a higher number of parameters can result in more complex issues. Therefore, it is advisable to exercise caution. While a larger number of parameters may create a sense of control over the problem, it can significantly complicate operational development as operational variables become sub-parameters.*
- *It is recommended to avoid multiplying the number of parameters and always prioritise the desired technical and indirect skills as reference points. Additionally, it is important to keep the parameters open in this phase, as new parameters may emerge in subsequent phases. The teaching team will decide the extent to which teams are allowed to progress without achieving all the planned parameters and whether they will be discovered later in the process.*

IDEAS FOR STUDENT GROUP

- *During this stage, the team must engage in self-reflection and ask themselves: What knowledge do we currently possess? What knowledge do we still need to acquire? It is a moment of exploration where the team can uncover what they already know and identify the areas they need to further develop in order to tackle the challenge. The group will collectively assess their existing knowledge and pose questions, recognizing that this stage is not definitive, as new uncertainties and inquiries will emerge as they gather more information.*

4.- Obtain and organise Information

The process of questioning from the previous stage intertwines with the pursuit of answers, creating a cyclical process where new questions may arise. Obtaining answers to these questions can involve a variety of approaches, such as theoretical and practical learning, open or guided research, master classes (mandatory or optional), tools for monitoring, visits, sessions with experts, workshop practices, skill development, and more. Critical analysis of information and verification of answers and acquired knowledge are integral to this stage.

IDEAS FOR THE TEACHING TEAM

- *This phase enables the acquisition of a technical foundation for subsequent stages, encompassing information in its broadest sense as long as it aligns with the established parameters. It is essential to allocate time for internalising skills and fostering the creation of new opportunities. Evaluation of various strategies should be considered, including the delivery of information through master classes, tailored to those who require it, or utilising puzzle techniques, among others. The search for information must consistently align with the desired learning outcomes for each specific challenge.*

IDEAS FOR STUDENT GROUPS

- *Don't underestimate your ability to learn independently. You have the capacity to acquire a wealth of knowledge on your own. However, remember to seek assistance when you encounter challenges or need guidance.*
- *Collaborate and share information not only within your team but also with other groups. By pooling your collective knowledge, you can strengthen your understanding of the parameters identified in the previous phase.*
- *To address the parameters, gather information from diverse sources, compare and organise it collectively with your team. This process will enable you to develop the knowledge necessary to generate alternatives and make informed decisions on how to effectively tackle the challenge.*

5.- Generate alternatives

Drawing upon the knowledge constructed in the preceding phases, the team engages in developing possible alternatives that address the identified challenges. It is advantageous to generate a multitude of options, as the more alternatives, the better. During this stage, it is beneficial to employ divergence techniques that encourage active participation from all group members, ensuring that everyone's ideas contribute to the creation of diverse alternatives.

IDEAS FOR THE TEACHING TEAM

- *Remember, quantity enhances quality. Encourage students to generate a wide range of responses and explore different ways to approach the challenge. Stepping out of their everyday workspace and routines can stimulate creativity. Consider incorporating creative spaces or seeking new experiences and environments.*
- *Facilitate a variety of creative dynamics that provide students with opportunities for imaginative thinking. It is important to guide the process so that students remain aligned with the intended objectives, ensuring their ideas do not stray too far from the desired outcomes as envisioned by the teaching team.*

IDEAS FOR STUDENT GROUPS

- *Unleash your creativity and embrace your role as creators. Allow yourself the opportunity to think outside the box.*
- *Challenge the status quo and resist the urge to settle for common solutions. Instead, push yourselves to envision original and unconventional approaches.*
- *Expand your creative repertoire by learning various techniques such as analogies and forced relationships. These techniques can spark new ideas and generate fresh perspectives.*
- *Collaboratively explore different options for addressing the challenge. This is the time for the team to brainstorm and generate diverse possibilities.*
- *Take note of where and when your best ideas tend to emerge, and make use of those conducive environments to foster creativity.*

6.- Present the Proposals

The objective of this phase is for each participant or group to articulate and share their developed proposals with the rest of the team. By doing so, all members gain insight into each other's ideas, enabling the process of selecting a proposal to commence.

IDEAS FOR THE TEACHING TEAM

- *Encourage each group or member to present their most viable proposal, fostering collaboration and enriching proposals through sharing. Actively listen to others, offer constructive contributions, and strive to enhance your own proposal.*
- *Practise effective communication skills.*
- *Learn from the perspectives and ideas of others.*

- *If it is an individual proposal, take note of its strengths and limitations.*
- *This is an opportune moment to practise active listening and refine communication abilities, ensuring that the contributions of each participant are thoroughly understood.*

IDEAS FOR STUDENT GROUPS

- *Present your idea with confidence and conviction.*
- *Attentively listen to the ideas of others, refraining from passing judgement at this stage. Focus on receiving and considering the proposals put forward by your fellow team members.*

7.- Select the Proposal

The team deliberates and evaluates each alternative to determine the most suitable solution for addressing the challenge. Contributions from all team members are valued as they provide valuable insights for making the final decision or even creating a new proposal.

IDEAS FOR THE TEACHING TEAM

- *The group should actively participate in the decision-making process and justify their choice of proposal. They can either choose one from the existing options or collaboratively develop a new proposal. It is crucial to ensure that the selected proposal aligns with the established parameters.*

IDEAS FOR STUDENT GROUPS

- *Explore techniques or procedures that can aid in selecting the best solution. Engage both your logical reasoning and intuition when making the decision. Avoid allowing personal pride or relationships with other team members to unduly influence your judgement. Evaluate different proposals objectively and choose the approach that best solves the challenge.*

8.- Plan actions

The team collaboratively agrees upon and organises all the necessary actions to be undertaken. This includes identifying associated tasks and assigning responsibilities, establishing a sequence and timeframe for completing tasks within the group, and addressing any potential risks through monitoring and analysis during the planning phase.

IDEAS FOR THE TEACHING TEAM

- *The teaching team will ensure a structured plan encompassing actions, timelines, risks, and allocated resources (such as machinery or workshops) as designated by the responsible individuals. They will also train the teams to work within a culture of milestones or deliverables, where intermediate steps must be completed before reaching the final product. The planning tool will be adapted to suit the students' abilities, and using simple, collaborative, and visual planning tools is recommended, particularly for younger students. Some tools, for example, categorise tasks into three levels: To Do, Doing, and Done, simplifying task management.*

IDEAS FOR STUDENT GROUPS

- *The group must recognize that while good planning may sometimes encounter obstacles, having no plan leads to disorder and chaos. The group should view itself as a means to an end rather than solely relying on the planning process.*
- *Once the team has identified the solution, it is time to design the process that will bring it to fruition. This involves identifying and dividing tasks, considering the individual learning commitments or areas that need attention, as well as time, roles, and resources. A plan should be formulated to outline the necessary steps and achieve the ultimate goal.*

9. Execute actions

The group initiates the planned actions, diligently monitoring and addressing any deviations that may arise. This phase promotes the development of specific skills and abilities through practical application and experimentation. It is important to actively assess whether the actions undertaken are yielding the expected learning outcomes.

IDEAS FOR THE TEACHING TEAM

- *The teaching team should closely observe whether the groups are effectively executing the identified tasks, adhering to deadlines, seeking guidance when needed, and effectively addressing any challenges or unexpected situations. This phase presents a suitable time for the teaching team to gather evidence for the evaluation process, especially through the use of checklists.*
- *By the end of this phase, the teaching team should anticipate tangible results in the form of products or services in most cases. However, it is essential to remember that the process itself is equally, if not more, important than the final outcome of the challenge.*

- *It is worth noting that certain limitations, such as restricted access to specific machines or workshops, may arise during this stage. The research team should proactively communicate this information to the groups, enabling them to consider such factors when planning their actions.*

IDEAS FOR STUDENT GROUPS

- *The team maintains a constant vigilance to ensure adherence to the schedule, promptly addressing and rectifying any deviations that arise.*
- *Embrace the work with enthusiasm and joy! This is the moment to implement the plan and strive for successful outcomes. It is important to remember that the ultimate objective is for all team members to acquire the comprehensive set of skills outlined in the curriculum by the end of the school year. Therefore, it is crucial to avoid over-specialization, ensuring that each member gains exposure to a diverse range of tasks and responsibilities.*
- *Never overlook the importance of personal protective equipment, safeguarding the facility, and prioritising environmental protection. These considerations should always be at the forefront of the team's actions.*

10. Expose Results

The team presents the outcomes of their challenge, either individually or in groups. It is crucial to ensure that the presentation goes beyond simply displaying the physical results and focuses on the learnings, personal discoveries, difficulties encountered, and other important aspects related to the challenge.

IDEAS FOR THE TEACHING TEAM

- *Teams may feel inclined to primarily showcase the tangible results achieved in the challenge. However, it is essential for the teaching team to guide the presentation towards highlighting the process of challenge development and the team's learning journey. This includes discussing the decisions made, successes achieved, mistakes encountered, and challenges faced. By emphasising these aspects, the focus is directed towards the subsequent phase of reflection and improvement.*
- *This phase also provides an opportunity for the teaching team to gather evidence for the evaluation process, particularly for assessing indirect skills.*
- *The teaching team should be cautious not to approach this phase merely as a project defence or oral examination. Instead, it is the perfect moment for students*

to reflect on what they have learned, acknowledge their mistakes, and showcase their motivation.

- *Consider whether it is appropriate to invite external actors, such as other teachers or companies, to attend the presentation. While their presence can bring a sense of seriousness and offer valuable insights for future students, it is important to strike a balance to ensure that the naturalness and level of self-criticism from the groups are not compromised.*

IDEAS FOR STUDENT GROUPS

- *This is the moment for the group to showcase their work, going beyond simply presenting the results or findings they have achieved. It is equally important to highlight the developmental processes the group has undergone throughout the challenge.*
- *Use this opportunity as a unique chance to enhance your skills, particularly in oral communication and presentation. While it is normal to feel nervous when speaking in public, the key is to strive for continuous improvement with each presentation.*

11. Evaluation of results

While it is crucial to engage in reflection and assessment throughout the entirety of the challenge, this juncture holds particular significance as it marks the culmination of the learning journey. During this feedback phase, the instructional team facilitates students' introspection regarding their acquired knowledge and successes, as well as areas for improvement identified during the challenge's progression. These identified areas will be documented as commitments.

IDEAS FOR THE TEACHING TEAM

- *The teaching team and students collaborate in a comprehensive evaluation that encompasses challenges, actions, attitudes, and the outcomes of this assessment for students. These elements serve as catalysts for reflection, guiding future endeavours towards improvement and growth in tackling challenges. Through feedback, both individually and as a group, students have the opportunity to identify areas in need of improvement and establish their learning commitments. The objective is to foster self-awareness regarding the distance they aim to cover, the progress they have genuinely made, the underlying reasons, and the commitments they intend to uphold moving forward. It is equally important to consider their collective dynamics and determine the necessary steps to be taken.*

- *To facilitate this process, the teaching team can employ digital tools or paper-based formats that provide clear and easily comprehensible feedback. These tools allow students to gain a transparent view of their current skill level and track their evolution over time, while adhering to the principles outlined in the Decalogue.*
- *While this phase may be a suitable time for more formal feedback, it is crucial to maintain a continuous flow of feedback throughout the challenge, encompassing both formal and informal approaches. Formal feedback should leverage future challenges as opportunities to reinforce improvement and evolution commitments.*

IDEAS FOR STUDENT GROUPS

- *It is essential for student groups to perceive assessment and feedback as continuous processes that support and guide learning not only at the culmination of a challenge but throughout the entirety of the school year. These processes serve as valuable tools for growth and development.*
- *The team should recognize that sometimes the journey holds more significance than the destination. Each team member must learn to both receive and provide constructive feedback. When delivered effectively and received with openness, feedback becomes a precious gift that allows for personal improvement.*
- *Moreover, every team member should comprehend that withholding honest opinions, even with the intention of not adversely impacting grades, does not serve anyone's best interests. It is important to prioritise sincerity and transparency, understanding that genuine feedback is crucial for individual and collective progress.*

10. Student assessment.

In this PR3 we propose an assessment framework for the E-VET4AI project that focuses on evaluating students' performance in Collaborative Challenge-Based Learning (CCBL) methodology. The CCBL approach offers students the opportunity to engage in collaborative problem-solving, fostering their ability to continuously learn and adapt in our rapidly changing society.

In the context of CCBL, **assessment plays a crucial role** in not only grading students but also facilitating decision-making processes to improve self-directed learning (formative assessment) and the learning process itself (summative assessment). This encompasses both individual assessment and the evaluation of group commitments and contributions.

Our proposed evaluation framework is centred around placing the student at the core of the learning process. Its key principles are as follows:

- **Shared Vision:** Establishing a shared vision among the teaching team regarding the assessment process throughout the cycle.
- **Cultivating a Positive Classroom Environment:** Creating a supportive atmosphere where errors are viewed as learning opportunities, promoting a growth mindset among students.
- **Providing Opportunities for Growth:** Generating abundant opportunities for students to reflect on their performance and identify areas for improvement.
- **Visualising Thinking for Assessment:** Encouraging students to articulate their thought processes and make their learning visible, enabling effective assessment.
- **Evolving Rubrics:** Developing general rubrics that evolve and reflect the progressive nature of the learning process.
- **Effective Feedback:** Providing feedback that reinforces, expands, restructures, or adjusts student understanding based on clear and specific learning objectives, aiding consolidation in long-term memory.

For more information on the assessment approach and its implementation, we recommend referring to the attached resources, including videos, guides, and infographics on various aspects such as the assessment approach, design considerations, competency definition, rubric design, challenges and evidence, feedback and 360-degree evaluation, commitments, and grading.

We believe that implementing this assessment framework in the E-VET4AI project will allow for a comprehensive evaluation of students' performance in the CCBL methodology, ensuring their holistic development and fostering a culture of continuous improvement.

11. Challenge final evaluation

As part of Project Result 3 in the macro design of the E-VET4AI project, it is crucial to evaluate the challenges after they have been tested with students. This evaluation aims to identify areas for improvement and ensure that the challenges align with the project's objectives. In this text, we will explore various aspects to consider when evaluating challenges and determining potential areas for enhancement.

1. Time:

Evaluate the time allocated for completing the challenge. Assess whether the given timeframe was sufficient for students to engage with the task, collaborate effectively, and achieve the desired learning outcomes. Consider feedback from both students and teachers regarding any time-related constraints or opportunities for extending or optimising the challenge duration.

2. Resources:

Evaluate the availability and suitability of resources provided to students during the challenge. Consider whether the resources adequately supported the learning objectives and whether students had access to relevant materials, tools, or technologies. Assess feedback from students and teachers on the usefulness, comprehensibility, and appropriateness of the resources.

3. The Challenge Itself:

Examine the challenge design and content. Evaluate whether the challenge was engaging, relevant, and appropriately aligned with the objectives of the E-VET4AI project. Analyse feedback from students and teachers regarding the clarity of instructions, the level of complexity, and the authenticity of the problem or task presented. Identify any areas where the challenge could be refined or expanded to enhance the learning experience.

4. Teachers Team:

Assess the role of the teachers in facilitating the challenge. Consider feedback from both teachers and students regarding the guidance, support, and facilitation provided by the teachers throughout the challenge. Evaluate whether the teachers effectively promoted collaboration, provided timely feedback, and addressed any difficulties or questions that arose during the process. Identify areas where the teachers' role can be further optimised to enhance student learning.

5. Student Team:

Evaluate the collaboration and teamwork among students during the challenge. Consider feedback from both students and teachers on the level of engagement, cooperation, and contribution exhibited by the student teams. Assess whether students had ample opportunities to collaborate, communicate effectively, and leverage their collective skills and knowledge. Identify any challenges or areas where students may require additional support or guidance.

Conclusion:

Evaluating challenges after they have been tested with students is a crucial step in improving the learning experience within the E-VET4AI project. By considering aspects such as time, resources, the challenge itself, the teachers' team, and the student team, areas for improvement can be identified and addressed. This evaluation process ensures that the challenges align with the project's objectives, optimise learning outcomes, and foster effective collaboration and skill development among the students. Through continuous evaluation and refinement, the challenges can evolve and contribute significantly to the success of the E-VET4AI project.

CHALLENGE EVALUATION - AREAS FOR IMPROVEMENT

Time	
Resources	
The challenge itself	
Teachers team	
Student team	

12. Frequently Asked Questions

What reference is used when proposing the challenge, skills or learning outcomes?

When proposing challenges, it is essential to consider the acquisition of both indirect and technical skills. Therefore, the design of the challenge framework must account for the cycle approach and encompass the competencies required for successful immersion in the chosen professional field upon completion of the cycle. This entails considering the technical and indirect skills outlined by the Occupational Competency Dictionary (OCD), as well as additional skills deemed crucial based on industry experiences. Subsequently, the teaching team can make informed decisions regarding the strategic skills to be addressed, design challenges that target these skills, and evaluate them in a logical and progressive manner.

How do we know if a challenge is well designed?

The entire group of teachers must collaborate in the design process, ensuring that it adheres to the characteristics outlined in the first infographic on this page.

The design should encompass careful planning, incorporating elements such as learning, evaluation, and feedback dynamics. It should also determine the duration of the challenge, the allocation of resources, and the approach to be taken, among other considerations. This design process represents a significant challenge for teachers.

It is essential to establish consistency between the design of the challenge, including its dynamics, deliverables, and tasks, and the desired outcomes. These outcomes typically encompass both technical skills and indirect skills, which are expressed as objectives.

An effective measure of the challenge's success is to assess its implementation, verifying if it aligns with the initial design in terms of timing, physical spaces, and other relevant factors. Additionally, it is crucial to evaluate whether the intended objectives have been accomplished and make any necessary improvements based on the findings.

Is the concept of master classes disappearing entirely?

The objective of this model is to foster active student participation, enabling them to take centre stage in their learning process and guiding them towards independent discovery of answers and solutions. However, in certain subjects, the teacher's role as a facilitator becomes crucial, necessitating the use of master classes. There are two significant considerations to keep in mind:

- Firstly, these master classes should be integrated into the context of the challenge. For instance, during phase 4 where information gathering occurs, the knowledge imparted through master classes becomes relevant and meaningful to the students.

- Secondly, it is essential to gauge the students' actual need for these classes. In some cases, we can eliminate the need for master classes by energising and invigorating the various phases of the challenge.

Is it essential to adhere to the 11-step³ structure?

The division of the challenge into 11 steps serves a purpose: it provides opportunities for skill development, particularly indirect skills. Therefore, it is advisable to maintain this structure until both the teaching team and the students comprehend the significance of each step.

However, for transformation to occur, it is crucial to ensure that students remain at the forefront of the learning process and uphold the following principles:

The teaching team must ensure that the design allows for the practice of skills outlined in the challenge.

The design crafted by the teaching team should foster collaborative learning, anticipating moments for both group work and individual work.

Students must develop an awareness of their learning needs and take ownership of the inquiry process.

Students must engage in the divergence-convergence process when solving the challenge.

Students must actively make decisions, plan, and regulate their own learning.

Students must engage in reflective practices throughout the entire process, acknowledging progress made and identifying areas that require improvement.

³ The 11 steps Collaborative Challenge Based Learning is inspired in TKNIKA's approach TKNIKA: tknika.eus The Basque VET Applied Research Center

ANEX 1: TEACHERS' TEMPLATE

<CENTER LOGO>

<i>PROFESSIONAL FAMILY</i>	
<i>TRAINING VET COURSE</i>	
<i>MODULES THAT PARTICIPATE IN THE CHALLENGE</i>	
<i>Duration: n Sessions x h</i>	<i>Organisation: Groups n people</i>

Challenge *number*
challenge title

Short description

Two or three lines that give us some clue about the challenge

Challenge

Start date:	Total length:
Modules and hours	

Objectives / Learning Results (Relation to DCB requirements).

TECHNICIANS

1. *TECH Learning Outcome 1*
2. *TECH Learning outcome 2*
3. *TECH Learning Outcome 3*
4.

TRANSVERSAL

1. *TR Learning Outcome 1*
2. *TR Learning outcome 2*
3. *TR Learning Outcome 3*
4.

Create / Activate the Team

Expected duration:	actual duration:
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Depending on whether the team is formed

The challenge

1. Propose the challenge: introduce and present the teams with a problematic situation that they will need to resolve

Expected duration:

actual duration:

2. Identify and connect with the challenge: make sure that everybody in the teams is on the same page and understand all the aspects of the challenge

Expected duration:

actual duration:

3. Set parameters: guide teams to identify gaps in their knowledge within the scope of the challenge and plan their learning journey

Expected duration:

actual duration:

4. Obtain and organise information: teams gather and analyse relevant information to answer identified questions, facilitating deeper learning

Expected duration:

actual duration:

5. Generate alternatives: teams create diverse solutions on acquired knowledge to address identified challenges

Expected duration:

actual duration:

6. Present the proposals: members of the teams discuss their solutions with the other members to initiate selection process

Expected duration:

actual duration:

7. Select the proposal: teams evaluate the best solution among proposed alternatives

Expected duration:

actual duration:

8. Plan actions: members organise and schedule tasks, assigning roles and planning the chosen solution

Expected duration:

actual duration:

9. Execute actions: teams implement the plans, manage deviations and assess the effectiveness of the actions in achieving the outcomes

Expected duration:

actual duration:

10. Expose results: teams present project outcomes and learning experiences, including challenges faced and personal insights gained

Expected duration:

actual duration:

11. Evaluation of results: the teachers facilitate students evaluation regarding the outcomes, gained knowledge, successes and areas of improvement

Expected duration:

actual duration:

Note: the challenge recovery system or learning outcomes must be specified.

TIMING

Monday	Tuesday	Wednesday	Thursday	Friday

USED MATERIAL AND PEDAGOGICAL RESOURCES

CHALLENGE EVALUATION - AREAS FOR IMPROVEMENT

Time	
Resources	
The challenge itself	
Teachers team	
Student team	

ANEX 2: STUDENTS' TEMPLATE

<School Logo>

<i>PROFESSIONAL FAMILY</i>	
<i>TRAINING CYCLE COURSE</i>	
<i>MODULES THAT PARTICIPATE IN THE CHALLENGE</i>	
<i>Duration: n Sessions x h</i>	<i>Organisation: Groups n people</i>

<p>challenge no</p> <p>Challenge Title</p>
<p>Short description</p> <p>Two or three lines that give us some clue about the challenge</p>

The challenge

In this section, the detailed explanation of the Challenge to be solved must be made.

Objectives / Learning Outcomes

TECHNICIANS

1. *Learning Objective 1*
2. *Learning Objective 2*
3. *.../...*

TRANSVERSAL/SOFT SKILLS

1. Tasks to do

The task to be performed can contain the following elements:

- Generation of a memory.
- Detail the quality characteristics expected from the report (script that must contain, typefaces, plans and diagrams,...).
- Physical elements in the event that it was necessary to do, build,....
- Presentation to be made Detail the quality characteristics expected from the presentation (languages, presentation formats, distribution of speakers, minimum average times for each team member,...)

2. Evaluation criteria (As proposed by the participants of the e-VET4AI LTTA of Frankfurt)

- Technical Competences %50 (tasks that have to be carried out with their corresponding percentage)
- Transversal competences %50

3. Resources

- Bibliography
- interesting websites
- contact persons

4. timing

Monday	Tuesday	Wednesday	Thursday	Friday