CHALLENGES FOR CHALLENGE BASED LEARNING

https://www.assistant-erasmus.eu/

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ASSISTANT project

CHALLENGES DESCRIPTION

(4.1 activity)

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Contents

1. INTRODUCTION

In this project, challenge-based learning (CBL) scenarios are to be developed based on the DT curriculum. The challenges to be described should be suitable for use in one of the following Challenge based learning scenarios**:**

1. **Big data**
2. **Digital Education**
3. **Artificial Intelligence**
4. **Robot. & IoT**

Learners should complete the challenge in a learning scenario as **a practical assignment.** The workload for each CBL scenario is limited to **40 teaching hours in total**. This includes time for self-guided learning as well as work on the challenge. Therefore, the challenge itself should take **max. 20-25 hours** (estimated).

The learners will work on the challenge completely online by using different learning materials via a LMS.

Definition of challenge in the sense of CBL in this project

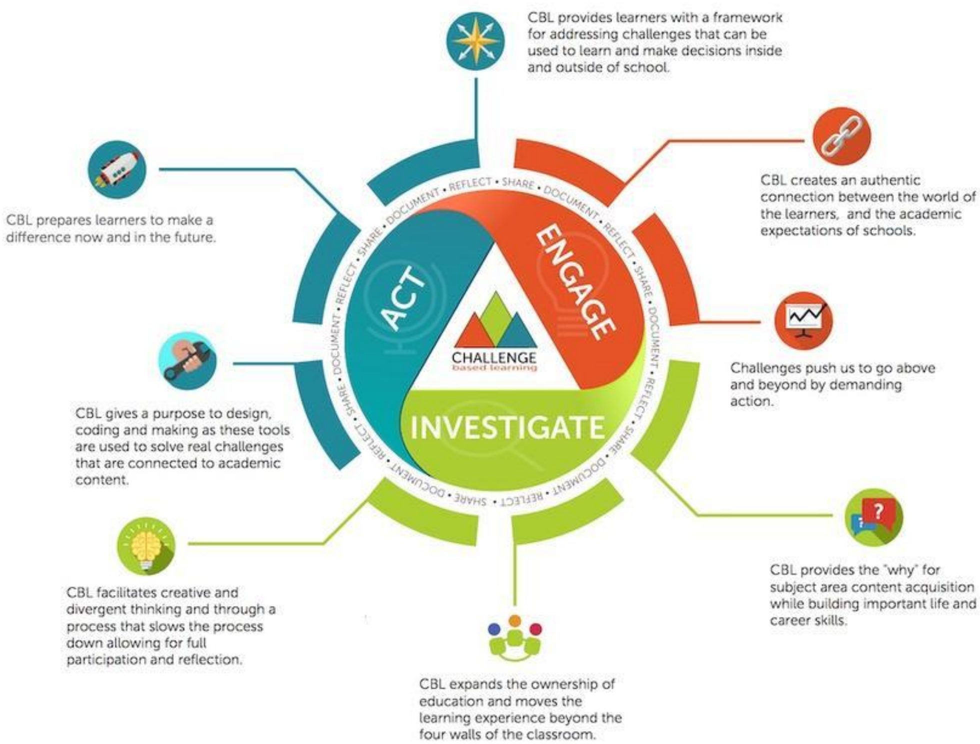
In order to comply with the given understanding of the project and its conditions, a challenge is a global or local problem with high relevance for its context. Based on a big idea the learners ask questions, discover and solve problems, gain in-depth subject area knowledge, develop new skills, and share ideas. Doing this learners acquire content knowledge in math, science, social studies, language arts, medicine, technology, engineering, computer science, arts etc.

The framework of a CBL is collaborative and hands-on.

Throughout the CBL process, learners are expected to document their experience, reflect on practice and share their results.

The main three stages of a CBL Process are:

1. **Engage:** Through a process of essential questioning, the learners move from an abstract Big Idea to a concrete and actionable challenge
2. **Investigate**: Next the learners plan and participate in a journey that builds the foundation for solutions and addresses academic requirements.
3. **Act:** in this stage the learners develop evidence-based solutions, implemented with an authentic audience, and then evaluated based on the results.



The challenge Dimension and complexity of the challenge should correspond to the learners skills and experience, the available workload and the methodical support.

Therefore the following dimensions of challenges should be considered:

- Nano Challenge are short in length (<2 Weeks) = 40 hours focus on a specific content area or skill, have tight boundaries, and are more directed. For more details read here: https://microcredentials.digitalpromise.org/explore/challenge-based-learning-nano-challenge
- Mini Challenge have a longer duration (2–4 weeks) allows for more in-depth research and reach of solutions. Taking a "show me what you can do" perspective, Mini Challenges are good for intense learning experiences that stretch the Learners and can be used to prepare Learners for Macro Challenges. More details: https://microcredentials.digitalpromise.org/explore/challenge-based-learning-mini-challenge
- The Macro Challenge builds on the skills of the Nano and Mini Challenges. Macro Challenges are longer (one month and longer) and allow considerable latitude for the Learners. More details: https://microcredentials.digitalpromise.org/explore/challenge-based-learning-macro-challenge

There are provided in total 4 challenges to be used in the project modules implementation.

2. CHALLENGES DESCRIPTION

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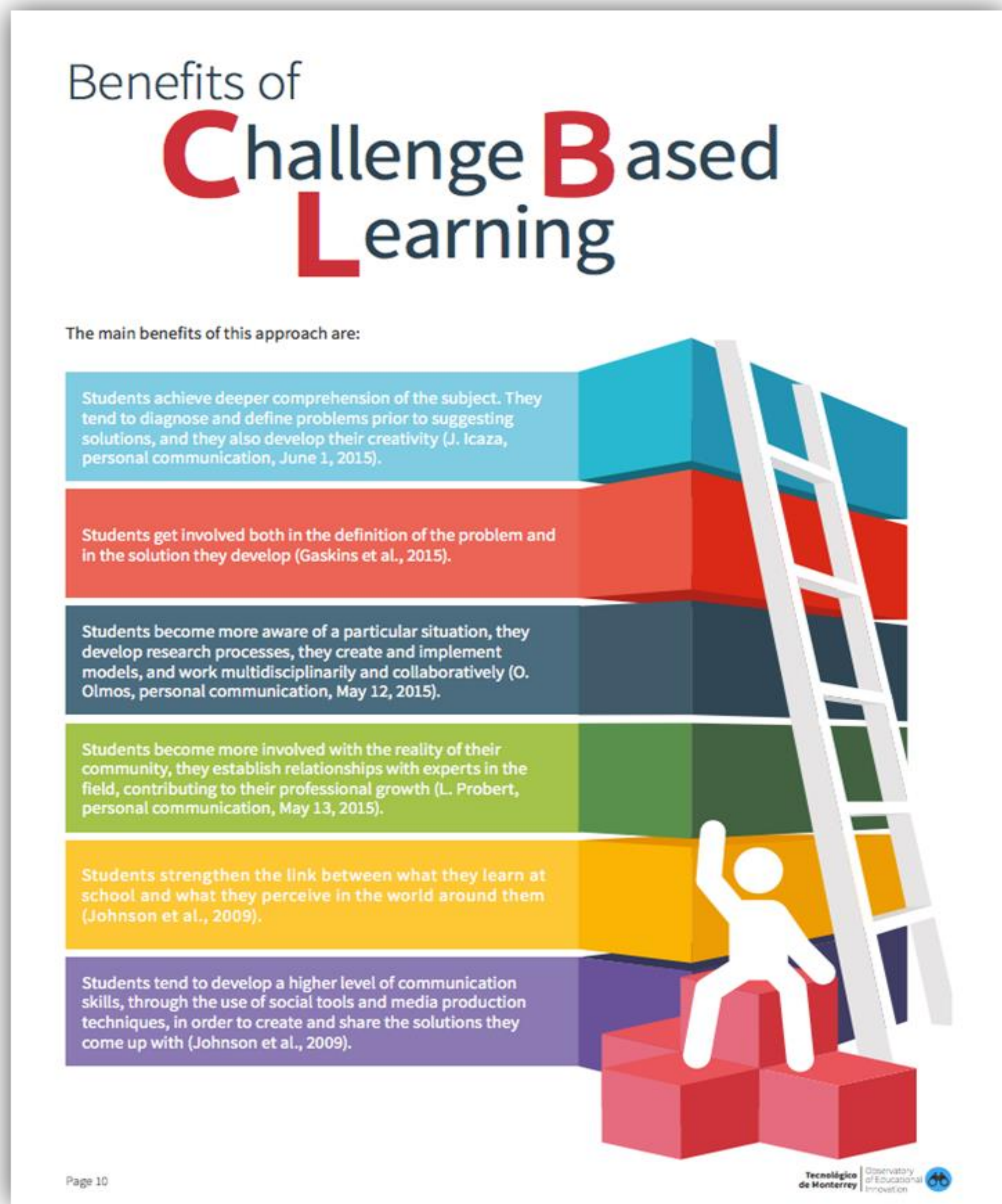

2.1. Big data: analysis and now casting of urban air pollution

The big idea: Awareness of air pollutants for urban populations

Challenge type: Mini (4 weeks)

Challenge owner: Local tourism info centre

Facilitator: Evaldas Vaiciukynas

Facilitator Contact data: Evaldas.Vaiciukynas@ktu.lt

Challenge is related to the topic of Big Data

Context & relevance: in general relating to SDG / specific to a field of vocational application

World Health Organization has worked to ensure that health-relevant indicators of household and ambient pollution exposure and disease burden are included in the formal system of SDG indicators.

SDG targets of relevance to ambient and household air pollution include:

SDG 3 – a substantial reduction in deaths and illnesses from air pollution;

SDG 11 – to reduce the environmental impact of cities by improving air quality.

Report on SDG 11 contains data on annual air pollution in cities. Nonetheless, more granular data (for example, daily statistics) would be useful for urban citizens for the purpose of monitoring local situation as well as planning activities or travel trips.

Variants of the challenge

World Air Quality Index project publishes a new dedicated data-set “Worldwide COVID-19 dataset”, updated 3 times a day, and covering about 380 major cities in the world, from January 2022 until now. Data contains daily statistics on the main air pollutant species (so2, pm25, pm10, co, o3) as well as meteorological factors (temperature, humidity, pressure, wind-speed, dew).

Variant 1: Finding dangerous pollution patterns. Analytics dashboard, visually summarizing historical tendencies of air pollution at a selected city. Solution should help to answer which months of the year and which days of the week have the largest levels of pollutants

Variant 2: Forecasting pollution a week ahead. Analytics dashboard, allowing to get forecast of air pollution at a selected city. Solution should allow to train a multivariate time-series model (neural network, ARIMAX, Prophet) on historical data. Since pollution levels are also dependent on meteorological factors, incorporating forecasts of these factors are important.

Business partner in an industry or a research field

Local tourism info centres, travel agencies, various environmental organizations.

Prerequisites of the learners

Challenge	knowledge	methods	practical experience
Variant 1 Finding dangerous pollution patterns.	SDG3, SDG11	*Data modelling Principles and Methods*	*Data modelling tools*
Variant 2: Forecasting pollution a week ahead.	SDG3, SDG11	*Data modelling Principles and Methods*	*Data modelling tools*

Functional requirements

Software: Data Application Modelling and -Programming:

Hardware: N/A

Working Space: Research labs

Impact

Report on SDG11 contains data on annual air pollution in cities. Nonetheless, more granular data (for example, daily statistics) would be useful for urban citizens for the purpose of monitoring local situation as well as planning activities or travel trips.

Open Issues and questions

2.2. Environmentally friendly agriculture

Name: Agriculture Bot

The big idea: Environmentally friendly agriculture

Challenge type: Standard, Strategic, Nano

Challenge owner: Class Agricultural Machines, Harsewinkel, Germany

Facilitator: Name, family name

Facilitator Contact data: name.familyname@gmail.com

Challenge is related to the topic of Robotic & IoT

Context & relevance: in general relating to SDG / specific to a field of vocational application

Innovation in terms of robotics applications in agriculture has advanced during in the last 5 years. The objective of agricultural robotics is to help the sector in its efficiency and in the profitability of the processes. In other words, mobile robotics works in the agricultural sector to improve productivity, specialisation and environmental sustainability. Factors such as labour shortages, rising consumer demand and high production costs have accelerated automation in the sector to reduce costs and optimise harvests.

Some applications in agriculture for which Robotnik is used:

- Detecting the condition of crops and applying chemicals accordingly, spraying or harvesting, depending on the needs of the fruit or plant.
- Mobile robots for harvesting and processing
- Collection and transformation of useful information for the farmer.

- Selective use of pesticides.
- Selection to avoid food waste

https://robotnik.eu/robotics-applications-in-agriculture/#pll_switcher

Variants of the challenge

In order to recognize the condition of a plant and to be able to use appropriate pesticides in a targeted and gentle manner, certain agricultural machines have appropriate sensors

With the help of these sensors and data processing, the condition of the plant can be determined by changes in leaf color and shape.

Variant 1: Develop an information architecture for a simple agriculture robot that uses a colour sensor to detect darkly discoloured plant leaves and then treats the leaf with pesticide.

Variant 2: Develop Information architecture and an simple mBot (MakeBlock) prototype of a simple agriculture robot that uses a colour sensor to detect darkly discoloured plant leaves and then treats the leaf with pesticide.

Business partner in an industry or a research field

Business partner: Class, Harsewinkel, Germany

Manufacturer of Agricultural machinery, Agriculture Robotics, Agriculture Robotics research Institutes

The interest of these Partners is in:

- Attracting young professionals
- Employee branding
- Expanding cooperation with universities

Possible cooperation could consist of:

- Material support (e.g. hardware)
- Know how support (e.g. software)
- Sponsoring (e.g. laboratory materials)

Prerequisites of the learners

Challenge	knowledge	methods	practical experience
Variant 1 Develop a software Modell for a simple agriculture robot	Structure and components of a robot system, sensoric and actuatoric	*Software modelling Principles and Method*	*Software modelling Software tools*
Variant 2 Develop a simple Hardware prototype of a agriculture robot	Structure and components of a robot system, sensoric and actuatoric	*Software modelling, Robot programming procedure.* *Prototyping Hardware (e.G. Arduino)*	*Software modelling Software tools* *Editing and creating new programmes,* *Assembling Prototype Hardware (e.G. Arduino)*

Functional requirements

Software: No Code application for Application Modelling and -Programming:

Hardware: Small scale robotic system and components: MakeBlock with color sensors, actuators and mobility functions.

Working Space: complete Mobile? Software lab, Robotic Lab?

Impact

Robotic systems enable innovative methods for the environmentally friendly management of agricultural land. By means of special sensor and actuator technology, the use of chemical agents for pest control can be reduced to a minimum. This not only protects the environment but also reduces the need for cost-intensive chemical substances.

Evaluation methods: for example, by comparing the use of chemical agents without and with the aid of robotics.

Open Issues and questions

How can we estimate the workload related to Competence and Challenge level?

How can we define what kind of support the learners get related to their competence level?

How far should specific hardware be assumed?

Which standard methods (e.g. software modelling) are required?

2.3. Agriculture Robotics for Plant Care

Name and general facts of the challenge

Name: Agriculture Robotics for Plant Care

The big idea: Environmentally friendly agriculture

Challenge type: Standard, Strategic, Nano

Challenge owner: The challenge is coordinated University of Twente (Netherlands)

Facilitator: Jochen Dickel

Facilitator Contact data: Jochen.Dickel@fh-mittelstand.de

CBL scenario, the challenge is related to the topic Robotic & IoT

Context & relevance: in general relating to SDG / specific to a field of vocational application

Innovation in terms of robotics applications in agriculture has advanced during in the last 5 years. The objective of agricultural robotics is to help the sector in its efficiency and in the profitability of the processes. In other words, mobile robotics works in the agricultural sector to improve productivity, specialisation and environmental sustainability. Factors such as labour shortages, rising consumer demand and high production costs have accelerated automation in the sector to reduce costs and optimise harvests.

Some applications in agriculture for which Robotnik is used:

- Detecting the condition of crops and applying chemicals accordingly, spraying or harvesting, depending on the needs of the fruit or plant.
- Mobile robots for harvesting and processing

- Collection and transformation of useful information for the farmer.
- Selective use of pesticides.
- Selection to avoid food waste

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Variants of the challenge

In order to recognize the condition of a plant and to be able to use appropriate pesticides in a targeted and gentle manner, certain agricultural machines have appropriate sensors

With the help of these sensors and data processing, the condition of the plant can be determined by changes in leaf color and shape.

Variant 1: Develop an information architecture for a simple agriculture robot that uses a color sensor to detect darkly discolored plant leaves and then treats the leaf with pesticide.

Variant 2: Develop Information architecture and an simple Arduino prototype of a simple agriculture robot that uses a color sensor to detect darkly discolored plant leaves and then treats the leaf with pesticide.

Business partner in an industry or a research field

Business partner: N/A

Manufacturer of Agricultural machinery, Agriculture Robotics, Agriculture Robotics research Institutes

The interest of these Partners is in:

- Attracting young professionals
- Employee branding
- Expanding cooperation with universities

Possible cooperation could consist of:

- Material support (e.g. hardware)
- Know how support (e.g. software)
- Sponsoring (e.g. laboratory materials)

Prerequisites of the learners

Challenge	knowledge	methods	practical experience
Variant 1 Develop a software Modell for a simple agriculture robot	Structure and components of a robot system, sensoric and actuatoric	*Software modelling* *Principles and Method*	*Software modelling* *Software tools*
Variant 2 Develop a simple Hardware prototype of a agriculture robot	Structure and components of a robot system, sensoric and actuatoric	*Software modelling, Robot programming procedure.* *Prototyping Hardware (e.G. Arduino)*	*Software modelling* *Software tools* *Editing and creating new programmes,* *Assembling Prototype Hardware (e.G. Arduino)*

Functional requirements

Software: for Application Modelling and -Programming,

Hardware: Robotic System and Components (e.g. color sensors, robot arm, …

Working Space: complete Mobile? Software lab, Robotic Lab?

Impact

Robotic systems enable innovative methods for the environmentally friendly management of agricultural land. By means of special sensor and actuator technology, the use of chemical agents for pest control can be reduced to a minimum. This not only protects the environment but also reduces the need for cost-intensive chemical substances.

Evaluation methods: for example, by comparing the use of chemical agents without and with the aid of robotics.

Open Issues and questions

How can we estimate the workload related to Competence and Challenge level?

How can we define what kind of support the learners get related to their competence level?

How far should specific hardware be assumed?

Which standard methods (e.g. software modelling) are required?

2.4. Digital Education: Enhancing Learning with Telepresence Robots

The big idea: Bridging Distance and Enhancing Engagement in Learning through Telepresence Robots

Challenge type: Mini (4 weeks)

Challenge owner: Tallinn University

Facilitator: Sirje Virkus

Facilitator Contact data: sirje.virkus@tlu.ee

Challenge is related to the topic of Digital Education

Context & relevance: in general relating to SDG / specific to a field of vocational application

In general, the challenge of using telepresence robots (TPR) in education aligns with the United Nations Sustainable Development Goal (SDG) 4: Quality Education. SDG 4 aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. By leveraging TPRs, this challenge addresses the need for equitable access to education, especially for learners who are unable to physically attend classes due to distance, illness, or other barriers.

Specific to the field of vocational application, the context and relevance of using TPRs in vocational education can be highlighted as follows:

- *Enhancing Access to Vocational Education*: TPRs can enable learners in remote or underserved areas to access quality vocational education. By connecting learners with vocational training centers or expert instructors, TPRs bridge the geographical gap and provide equal opportunities for skill development and vocational training.

- *Real-time Collaboration and Mentorship:* Vocational training often requires hands-on practice and guidance from experienced mentors. TPRs allow learners to remotely participate in workshops, apprenticeships, or on-the-job training, enabling real-time collaboration and mentorship regardless of geographical constraints.
- *Cost-Effective Training Solutions*: Vocational training can be costly, especially when learners need to travel or relocate to training centers. TPRs offer a cost-effective solution by reducing travel expenses and eliminating the need for physical presence, making vocational education more accessible and affordable for learners.
- *Industry-Relevant Skill Development:* Vocational education aims to equip learners with practical skills relevant to specific industries. TPRs can facilitate virtual simulations, remote demonstrations, or interactive training sessions, allowing learners to gain industry-specific skills and knowledge without being physically present in a particular workplace or industry setting.
- *Sustainable Workforce Development*: By enabling remote vocational education, TPRs contribute to building a sustainable workforce. Learners can acquire skills in emerging fields or specialized areas without the need for extensive travel or relocation, promoting a sustainable approach to skill development and reducing the carbon footprint associated with traditional vocational education.

Variants of the challenge

Variant 1: Enhancing Vocational Skills Training in Rural Areas with TPRs

Challenge Description: You are part of a team tasked with addressing the challenge of limited access to vocational skills training in rural areas. Your task is to design and implement a telepresence robot-based solution that enables learners in remote rural communities to access high-quality vocational education and training without the need for extensive travel or relocation.

Variant 2: Promoting Inclusive Vocational Education for People with Disabilities through TPRs

Challenge Description: You are part of a team working towards promoting inclusive vocational education for people with disabilities. Your task is to develop an innovative telepresence robot-based solution that facilitates equal access to vocational education and training opportunities for individuals with disabilities. The solution should empower learners to actively participate in vocational programs, engage with instructors and peers, and gain practical skills necessary for employment, regardless of their physical limitations or geographical location.

Business partner in an industry or a research field

Tallinn University of Technology Creativity Matters research group

Prerequisites of the learners

Challenge	knowledge	methods	practical experience
Variant 1 Enhancing Vocational Skills Training in Rural Areas with TPRs	Understanding telepresence robotics, technology integration, learning design, didactics, accessibility, and inclusive practices.	*learning design, didactic methods, technology integration frameworks*	*Practical skills needed to design and deploy effective TPR-based solutions. They will acquire transferable skills in hardware setup, integration, user training, collaboration facilitation, evaluation, and reflection, which can be applied to various educational and professional contexts.*

Variant 2: Promoting Inclusive Vocational Education for People with Disabilities through TPRs	Understanding telepresence robotics, technology integration, learning design, didactics, accessibility, and inclusive practices	*learning design, didactic methods, technology integration frameworks*	*Practical skills needed to design and deploy effective TPR-based solutions. They will acquire transferable skills in hardware setup, integration, user training, collaboration facilitation, evaluation, and reflection, which can be applied to various educational and professional contexts.*

Functional requirements

Software: N/A

Hardware: TPRs (Double, Ohmni, Temi)

Working Space: Research labs

Impact

Both variants of Challenge-based learning scenarios utilizing TPRs have the potential to enhance access, affordability, inclusivity, and skill development in vocational education and training. They can bridge geographical gaps, empower learners with disabilities, and contribute to their personal and professional growth.

Open Issues and questions

While implementing the telepresence robot-based solutions for vocational education and training in rural areas or for individuals with disabilities, several open issues and questions may arise. Here are some related considerations:

- *Connectivity and Infrastructure:* One significant challenge is ensuring reliable internet connectivity and infrastructure in rural areas or locations with limited resources. Without stable and high-speed internet access, the effectiveness and accessibility of telepresence robot-based solutions can be compromised.
- *Cost and Affordability:* The cost of implementing and maintaining TPRs can be a barrier to widespread adoption, particularly in economically disadvantaged regions or for individuals with disabilities who may face financial constraints. Addressing the cost aspect and exploring funding options or alternative solutions is essential.
- *Training and Technical Support:* Providing training and technical support to users, including learners, instructors, and administrators, is crucial for successful implementation. Questions may arise regarding the training required to operate the TPRs, troubleshoot technical issues, and effectively utilise the associated software and platforms.
- *User Experience and Accessibility*: Ensuring a positive user experience and accessibility for all learners, including those with varying levels of technical expertise or disabilities, is essential. Questions may arise regarding the user interface, adaptability to different learning styles, accessibility features, and customisation options to meet individual needs.
- *Privacy and Security:* Telepresence robot-based solutions involve transmitting audio, video, and other sensitive data. Questions may arise concerning data privacy, security measures, and compliance with regulations to protect learners' personal information and maintain confidentiality during remote interactions.
- *Pedagogical Approaches:* Exploring and adapting pedagogical approaches suitable for TPR-based vocational education and training is important. Questions may arise regarding the effectiveness of remote learning methodologies, collaboration strategies, assessment

methods, and the integration of practical, hands-on experiences into remote vocational training.

- *Social and Emotional Engagement:* TPRs should aim to replicate the social and emotional aspects of in-person vocational education. Questions may arise about how to foster peer interactions, create a sense of belonging, and support learners' social and emotional well-being in remote settings.
- *Regulatory and Policy Considerations:* The implementation of TPRS for vocational education may require compliance with local regulations and policies. Questions may arise regarding licensing, accreditation, liability, and legal frameworks surrounding remote learning and the use of robotic technologies in education.
- *Long-term Sustainability:* Ensuring the long-term sustainability of TPR-based solutions involves addressing factors such as equipment maintenance, software updates, scalability, and the availability of resources for ongoing support and development.
- *Evaluation and Research:* Assessing the effectiveness, impact, and outcomes of TPR-based vocational education and training is crucial. Questions may arise about the methodologies used to evaluate learner performance, skill development, educational outcomes, and the overall efficacy of these solutions compared to traditional approaches.

Addressing these open issues and questions through ongoing research, collaboration, and stakeholder engagement is essential for the successful implementation and continuous improvement of telepresence robot-based vocational education and training initiatives.