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Hydrogen Trainer Excellence – Webinar 1: Teaching Diverse Learners

Inclusive strategies, differentiation, and accessibility in hydrogen training

30 / 01 / 2026 – Online

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Agenda

- Introduction to the Project
- Overview of the Webinar Series
- Understanding Learner Diversity
- Contrasting Approaches to Core Concepts
- Inclusion and Accessibility in Hydrogen Training
- Participation & Reflection

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Introduction to the H2VE Project

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H2VE Project Overview

- H2VE is an international Erasmus+ project building a network of Centres of Vocational Excellence (**CoVEs**) to strengthen **hydrogen skills and training ecosystems**.
- It supports the development of sustainable **Hydrogen Valleys** by preparing a skilled workforce capable of meeting current and future industry demands.
- A total of six CoVEs are being established across Europe and Africa (Germany, Italy, Poland, Latvia, Greece, Ghana) to deliver **targeted vocational training and education**.
- H2VE fosters **cross-sector collaboration** between education providers, industry partners, and policymakers to ensure training is practice-oriented and aligned with real labor market needs.

H2VE Objectives & Impact

Core Objectives

- Identify skills needs in Hydrogen Valleys and emerging hydrogen tech to close the skills gap.
- Design & deliver tailored training programs for students, educators, and SMEs focused on hydrogen technologies.
- Develop digital and collaborative learning tools that enhance accessibility and flexibility of training.
- Facilitate partnerships and knowledge sharing among education, industry, and public stakeholders.
- Ensure sustainability and long-term impact through quality assurance and strategic planning.

Expected Impact

- Creation of a transnational skills ecosystem that prepares professionals for the hydrogen economy.
- Promotion of lifelong learning and upskilling/reskilling pathways in hydrogen and related sectors.
- Strengthening of regional innovation systems and competitive hydrogen value chains.

Overview of the "Hydrogen Trainer Excellence" Webinar Series

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Hydrogen Trainer Excellence

Complementing webinar for the project's deliverable "Guide for the Trainer Curriculum"

- Informative and interactive 60-90 min sessions
- Seminars every three weeks with recordings for flexibility
- Practical Takeaways: templates, rubrics and strategies ready to implement

Webinar	Webinar Focus
Webinar 1 – Week 1	Teaching Diverse Learners in Hydrogen Training
Webinar 2 – Week 4	Designing Modular Curricula & Assessments
Webinar 3 – Week 7	Active Learning & Soft Skills Integration
Webinar 4 – Week 11	Digital Tools & Blended Hydrogen Training
Webinar 5 – Week 13	Regional Adaptation & Continuous Improvement

Expected Learning Outcomes of this Webinar

By the end of this webinar you will be able to:

- Identify the strengths, gaps and motivations of different hydrogen learner groups
- Adapt teaching content for diverse audiences while maintaining the same learning outcomes
- Apply Universal Design for Learning principles to make hydrogen training more accessible and inclusive

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Understanding Learner Diversity

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Why Learner Diversity Matters

- More work and jobs are emerging in the field of hydrogen
- Hydrogen training attracts **heterogeneous groups**: varying ages, professions, sectors and even countries
- Vastly varying **prior knowledge** (e.g. knowledge in fossil fuels vs. knowledge in renewables)
- Without differentiation, teaching content is too easy for some and overwhelming for others
- **Goal**: same learning outcomes with different pathways to reach them

Key Learner Populations in Hydrogen Training

- Career Changers (often from oil & gas, power, manufacturing)
- Young Professionals (students, recent graduates in STEM/VET)
- Technicians (maintenance, operations, field work)
- Engineers (design, modelling, simulations)
- Trainers/Educators (educational institutions, workforce trainers)
- Three **target groups** of H2VE: Students, Workforce, Trainers

Main areas of desired hydrogen training (Hydrogen Skills Alliance, 2024)

Green Skills for Hydrogen (2023), Hydrogen Skills Alliance (2024)

Career Changers

- **Strengths:**
  - Practical experience with industrial systems, safety culture or work processes
  - Existing mental models of energy systems and risks
- **Typical Gaps:**
  - Hydrogen-specific properties, technologies, new regulations
- **Motivations:**
  - Employability, relevance of prior skills, stable transition into green jobs
- **Implications for trainers:**
  - Start from what they already know (e.g. gas networks, turbines,…)
  - Emphasize similarities/differences between the “old” known technologies and the “new” ones

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Young Professionals

- **Strengths:**
  - Recent theoretical and at times practical knowledge, digital skills, learning habits
- **Typical Gaps:**
  - Limited workplace experience, safety routines, tacit knowledge
- **Motivations:**
  - Innovation, sustainability, “cutting-edge” technology, career progression
- **Implications for trainers:**
  - Connect theory to practice; use projects, simulations, site examples
  - Make safety and procedural discipline visible and concrete

Technicians

- **Strengths:**
  - Hands-on skills, troubleshooting, familiarity with tools and equipment
- **Typical Gaps:**
  - Abstract modelling, systems-level thinking, advanced electrochemistry
- **Motivations:**
  - Doing their job better, avoiding mistakes, safe and efficient operations
- **Implications for trainers:**
  - Emphasize the “how” and “why” of procedures, checklists, demonstrations
  - Use clear diagrams, stepwise instructions, practical scenarios

Engineers

- **Strengths:**
  - Strong math/physics, system modelling, design thinking
- **Typical Gaps:**
  - Real-world constraints, operations, maintenance nuances
- **Motivations:**
  - Optimization, innovation, solving complex problems
- **Implications for trainers:**
  - Go deeper into equations, trade-offs, standards and design constraints
  - Integrate field feedback and operational data into tasks

Trainers/Educators

- **Strengths:**
  - Pedagogical expertise, curriculum design skills, group facilitation
  - Experience managing diverse classrooms and learning styles
  - Understanding of assessment and feedback cycles
- **Typical Gaps:**
  - Cutting-edge hydrogen technologies and performance data
  - Current industry standards
  - Hands-on familiarity with latest equipment (electrolysers, stacks)
- **Motivations:**
  - Stay current in rapidly evolving field, deliver relevant content
  - Help learners succeed, bridge theory-to-practice gap
  - Build reputation for high-quality hydrogen training programs
- **Implications for trainers:**
  - Structured refreshers to keep updated on new technologies with short modules
  - Stay connected to Hydrogen Valley developments

HySkills (2022), Hydrogen Skills Alliance (2024)

Examples of Learning Pathways of a Training Program for Sustainability in Hydrogen Systems

Pathway	EQF Level	Target Audience	Core Focus
Foundation	3-4	New entrants, apprentices, career changers	H_2 fundamentals, Introduction to Sustainability and Circularity
Professional	5	Technicians, operators, junior engineers	Practical sustainability assessment
Specialist	6	Engineers, project managers, graduates	LCA, circular design, optimization
Expert	7-8	Senior engineers, researchers, consultants	Advanced research, policy, innovation
Management & Policy	–	Managers, policymakers, executives	Strategic planning, compliance
Short Courses	All	Professionals seeking specific skills	Specialized topics, updates

Key Takeaways on Learner Diversity

- Different groups bring different assets – use them!
- Prior knowledge and misconceptions must be made visible
- Motivation sources differ – safety, innovation, job stability, status, sustainability
- One-size-fits-all teaching is rarely effective in (hydrogen) training

10-minute Coffee Break

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Contrasting Approaches to Core Concepts

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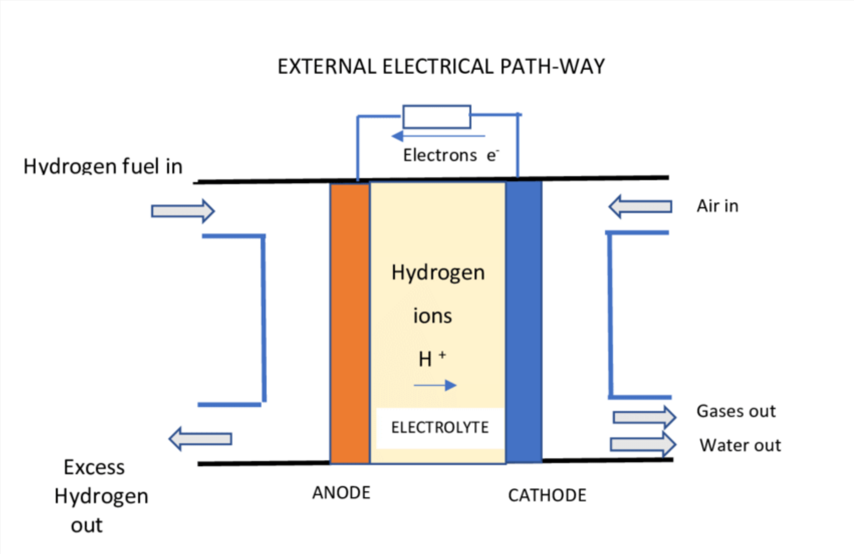
Adapting Material Based on the Target Groups

Different learners don't need different content, they need **different entry points**.

Goal: Achieve the same learning outcomes while changing the language, depth, context and examples

Here: Simple fuel cell electrochemistry as a reference concept.

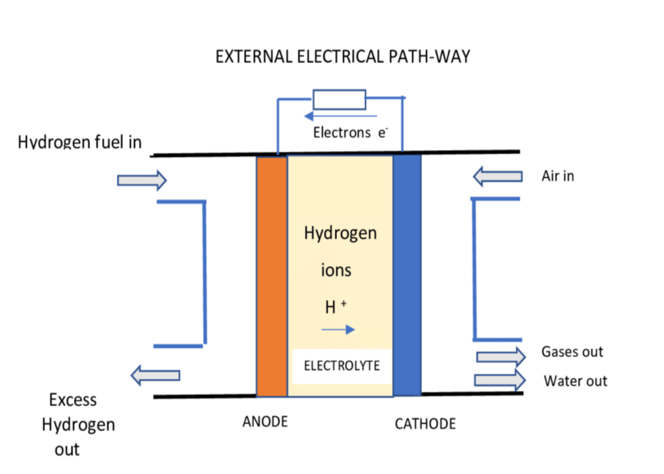


Schematic Diagram of a Hydrogen Fuel Cell (Murray-Smith, 2019)

Fuel Cells for Students

- In a fuel cell, **hydrogen and oxygen react to produce electricity**
- Hydrogen enters the fuel cell at the anode
- At the anode, hydrogen is split into:
  - **protons**, which move through the membrane
  - **electrons**, which move through an external circuit and create electric current
- Oxygen enters at the **cathode**
- At the cathode, oxygen combines with protons and electrons to form **water**
- This process produces:
  - electricity
  - heat
  - water as the only by-product

Key Takeaway: Fuel cells convert chemical energy directly into electrical energy, cleanly and efficiently.



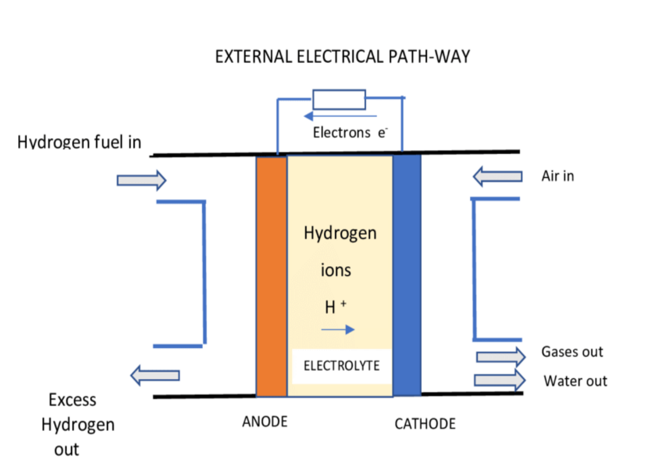
Schematic Diagram of a Hydrogen Fuel Cell (Murray-Smith, 2019)

Fuel Cells for Workforce

- In a PEM fuel cell, electricity is generated by an **electrochemical reaction**, not by burning hydrogen
- Hydrogen is supplied to the **anode**, where it is split into protons and electrons
- The membrane:
  - allows **protons** to pass
  - blocks **electrons**, forcing them through the external circuit
- This electron flow is what delivers usable electrical power
- At the cathode, oxygen reacts with protons and electrons to form **water**
- System performance depends on:
  - temperature
  - pressure
  - gas purity
  - membrane condition

Why this matters:

- many faults and efficiency losses originate at the electrochemical level
- Understanding the process improves troubleshooting and system handling

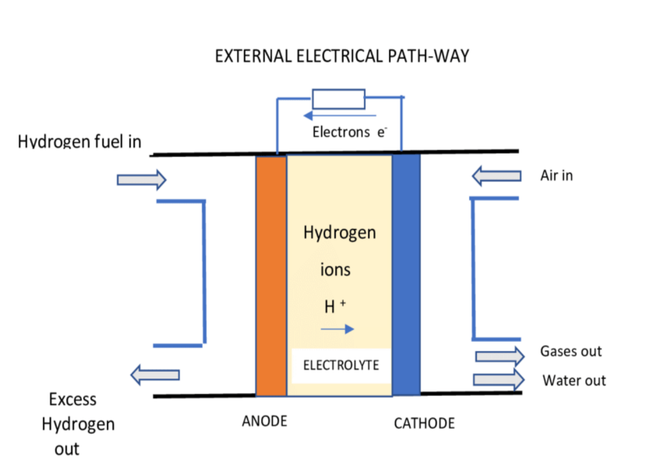


Schematic Diagram of a Hydrogen Fuel Cell (Murray-Smith, 2019)

Fuel Cells for Trainers

- Fuel cell electrochemistry is the **foundation** of all hydrogen system training
- In a PEM fuel cell:
  - hydrogen oxidation occurs at the **anode**
  - oxygen reduction occurs at the **cathode**
  - the **membrane** enables charge separation and controlled current flow
- **Electrical output** is determined by:
  - reaction kinetics at both electrodes
  - internal resistance (ohmic losses)
  - mass transport limitations
- **Efficiency** losses arise from:
  - activation overpotentials
  - ohmic resistance
  - concentration losses
- These electrochemical **principles** explain:
  - performance curves
  - degradation mechanisms
  - operational limits seen in real systems

Key Takeaway: A solid electrochemical understanding allows you to adapt explanations accurately, without oversimplifying or distorting the science.



Schematic Diagram of a Hydrogen Fuel Cell (Murray-Smith, 2019)

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Inclusion and Accessibility in Hydrogen Training

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Inclusion & Accessibility

- Inclusion and accessibility are staples of modern teaching
- Technical diversity is only one dimension
  - Learners also differ in (dis-)abilities, language, culture, learning preferences and time constraints
- **Goal**: Design hydrogen training that is useable by everyone from the start

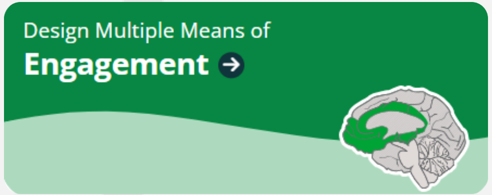
Universal Design for Learning (UDL)

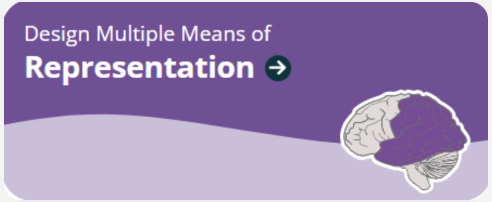
- Universal Design for Learning is a proactive design approach
- It assumes that:
  - learners differ in how they perceive information
  - learners differ in how they process and express understanding
  - learners differ in what motivates and engages them
- UDL focuses on designing for variability, not fixing individuals

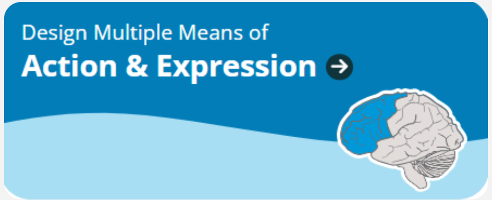
Barriers are often in the design, not in the learner!

CAST (2018)

The Three UDL Principles in Practice



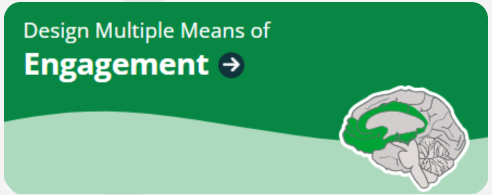


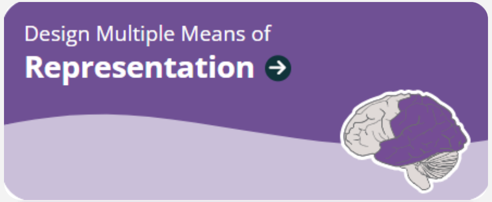


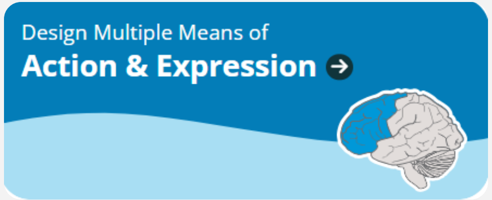
Multiple Means of Engagement

- Address **motivation, relevance, and persistence**
- Support learners who differ in:
    - confidence
    - attention
    - external constraints (work, family)
- Examples:
    - choice of examples or tasks
    - real-world relevance
    - collaborative activities and peer learning

The Three UDL Principles in Practice







Multiple Means of Representation

- Offer information in **different formats**
- Support learners with:
  - different language backgrounds
  - different sensory abilities
  - different levels of prior knowledge

- Examples:
  - diagrams + spoken explanation
  - captions and transcripts
  - simplified summaries alongside detailed material

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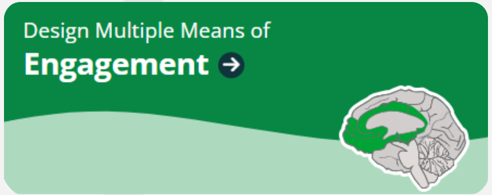
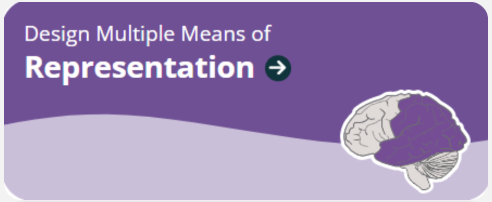
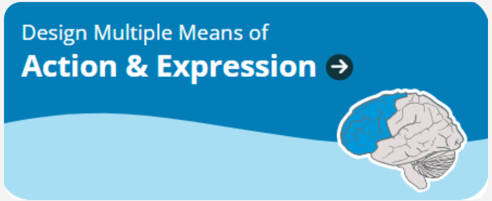
The Three UDL Principles in Practice







Multiple Means of Action & Expression

- Allow learners to **show understanding in different ways**
- Reduce barriers caused by:
  - writing difficulties
  - language proficiency
  - motor or processing differences

- Examples:
  - written answers, oral explanations, practical tasks
  - quizzes, discussions, demonstrations
  - digital tools instead of paper-only formats

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UDL Applied to Hydrogen Training

- Hydrogen topics can be **abstract** and **technically complex**
- UDL helps make hydrogen training:
    - **accessible** without oversimplifying
    - **flexible** without losing rigor
- One hydrogen concept can be taught through:
    - diagrams and system schematics
    - short explainer videos with captions
    - simulations or VR environments
    - hands-on demonstrations or lab tasks

From Content to Design Decisions

When designing a (hydrogen) training session, ask yourself:

- **Engagement** – Why should this learner care about this content?
- **Representation** – How many ways can learners access this content?
- **Action & Expression** – How many ways can learners demonstrate understanding?

Universal Design for Learning supports *all* learners,
not just those with visible needs

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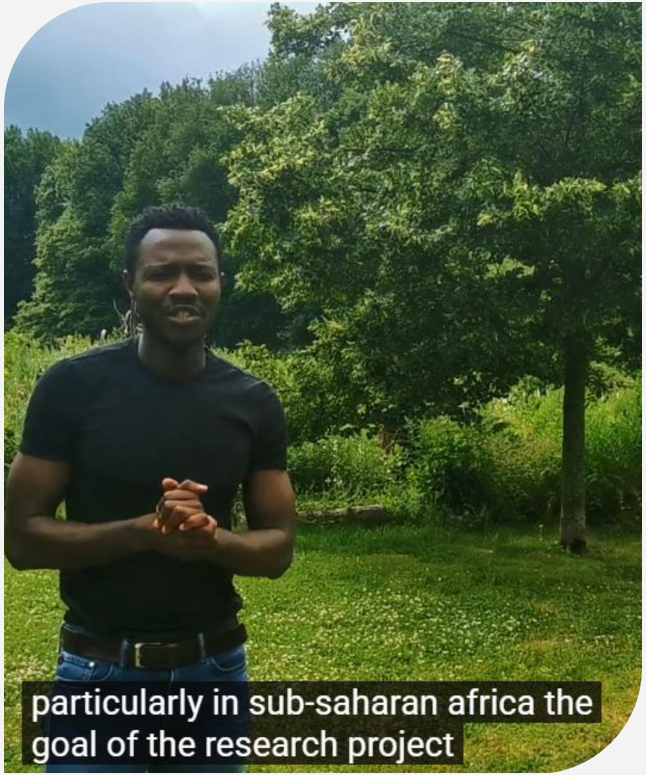
Inclusive Design: Practical Examples

Captions on videos help
- deaf learners
- non-native speakers
- in noisy environments



Excerpt from a YouTube-Video of one of BUAS' projects

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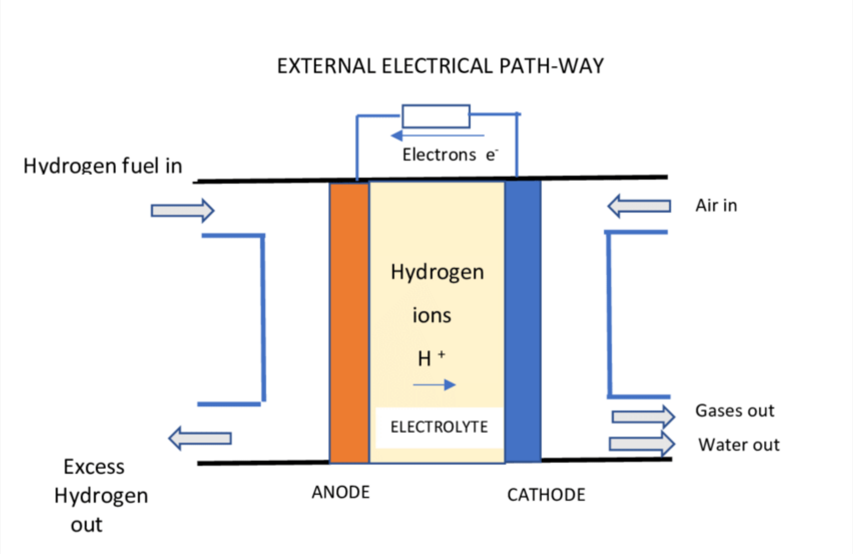
Inclusive Design: Practical Examples

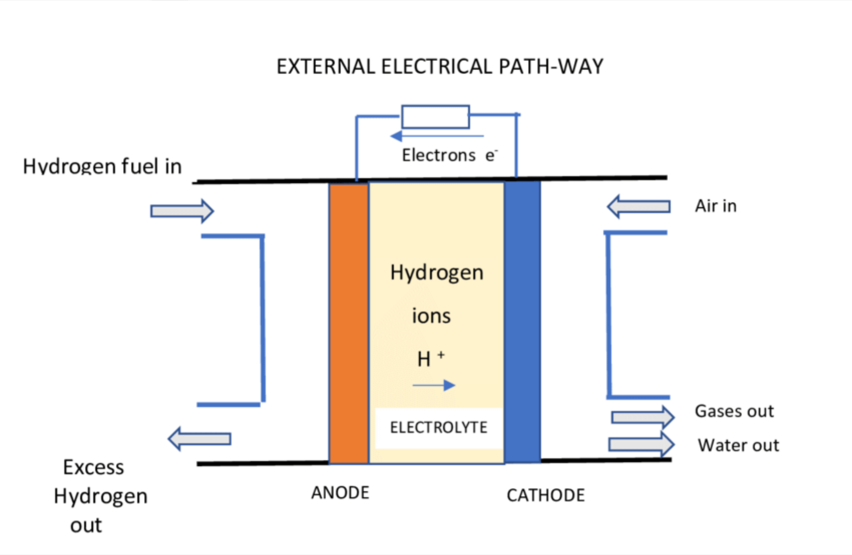
Visual and verbal explanations of diagrams



Schematic Diagram of a Hydrogen Fuel Cell (Murray-Smith, 2019)

Inclusive Design: Practical Examples

Visual and verbal explanations of diagrams



Schematic Diagram of a Hydrogen Fuel Cell (Murray-Smith, 2019)

PEM Fuel Cell Operation:

1. Hydrogen (H_2) enters anode
2. Catalyst splits $H_2 \rightarrow 2H^+ + 2e^-$
3. Protons (H^+) pass through membrane
4. Electrons flow through external circuit (→ electricity)
5. $O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$ at cathode

Inclusive Design: Practical Examples

Break content into smaller chunks with clear signposting and summaries

3. Pedagogical Foundations for Hydrogen Education

Effective hydrogen training is built on evidence-based pedagogical principles that optimize learning outcomes. *Student-centered learning* places learners as active participants in constructing knowledge rather than passive recipients of information. *Active engagement* emphasizes that learners develop understanding through hands-on activities, problem-solving, discussion, and application rather than passive listening or reading. *Alignment* ensures clear connections among learning objectives, instructional activities, and assessments so that what learners practice and how they are assessed directly relate to stated learning outcomes. *Constructivism* recognizes that learners build new understanding by connecting it to existing knowledge and experience, with instructors facilitating this meaning-making rather than simply presenting pre-constructed information. *Situated learning* develops knowledge within authentic contexts relevant to real-world hydrogen applications, recognizing that learning is more transferable when connected to meaningful situations. *Collaborative learning* acknowledges that learners develop understanding through interaction with peers, sharing perspectives, solving problems together, and providing mutual support. Finally, *metacognition* involves developing learner awareness of their own thinking processes, helping them monitor their understanding and adjust strategies as needed. Understanding how people learn hydrogen concepts helps shape effective training. The learning cycle begins with activating prior knowledge, connecting new learning to existing understanding, identifying misconceptions that might interfere with learning, and building relevance and motivation by showing why this content matters. Next comes introducing new concepts through presenting core principles and theories, using concrete examples and demonstrations, supporting visual, auditory, and kinesthetic learners, and making connections to prior knowledge that help learners integrate new information. Guided practice follows, where learners solve problems with trainer support, work through examples with scaffolding that gradually decreases as competence increases, ask questions and receive immediate feedback, and build confidence with increasing complexity. Application and problem-solving comes next, where learners apply learning to new contexts, solve authentic hydrogen-related problems, work independently or collaboratively depending on need, and transfer knowledge to workplace situations they will encounter. Finally, reflection and consolidation involves learners reflecting on their learning process, connecting new knowledge to broader understanding, identifying remaining questions for future exploration, and planning for continued learning beyond the formal program. Hydrogen training should engage learners across cognitive levels rather than focusing only on memorization or basic understanding. Bloom's Revised Taxonomy (Bloom, 1956) provides a valuable framework for this comprehensive approach. At the foundational level, remembering involves recall of facts, definitions, and

Modified excerpt from the H2VE Deliverable "Guide for Trainer Curriculum"

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Inclusive Design: Practical Examples

Break content into smaller chunks with clear signposting and summaries

3. Pedagogical Foundations for Hydrogen Education

3.1 Core Pedagogical Principles

Effective hydrogen training is built on evidence-based pedagogical principles that optimize learning outcomes. *Student-centered learning* places learners as active participants in constructing knowledge rather than passive recipients of information. *Active engagement* emphasizes that learners develop understanding through hands-on activities, problem-solving, discussion, and application rather than passive listening or reading. *Alignment* ensures clear connections among learning objectives, instructional activities, and assessments so that what learners practice and how they are assessed directly relate to stated learning outcomes. *Constructivism* recognizes that learners build new understanding by connecting it to existing knowledge and experience, with instructors facilitating this meaning-making rather than simply presenting pre-constructed information. *Situated learning* develops knowledge within authentic contexts relevant to real-world hydrogen applications, recognizing that learning is more transferable when connected to meaningful situations. *Collaborative learning* acknowledges that learners develop understanding through interaction with peers, sharing perspectives, solving problems together, and providing mutual support. Finally, *metacognition* involves developing learner awareness of their own thinking processes, helping them monitor their understanding and adjust strategies as needed.

3.2 The Learning Cycle in Hydrogen Training

Understanding how people learn hydrogen concepts helps shape effective training. The learning cycle begins with activating prior knowledge, connecting new learning to existing understanding, identifying misconceptions that might interfere with learning, and building relevance and motivation by showing why this content matters. Next comes introducing new concepts through presenting core principles and theories, using concrete examples and demonstrations, supporting visual, auditory, and kinesthetic learners, and making connections to prior knowledge that help learners integrate new information. Guided practice follows, where learners solve problems with trainer support, work through examples with scaffolding that gradually decreases as competence increases, ask questions and receive immediate feedback, and build confidence with increasing complexity. Application and problem-solving comes next, where learners apply learning to new contexts, solve authentic hydrogen-related problems, work independently or collaboratively depending on need, and transfer knowledge to workplace situations they will encounter. F...

Excerpt from the H2VE Deliverable "Guide for Trainer Curriculum"

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Accessibility Considerations

- **Hearing**: captions, transcripts, visual alerts for alarms
- **Vision**: high-contrast slides, screen-reader-compatible documents, descriptive text for diagrams
- **Motor**: keyboard-accessible digital tools
- **Neurodiversity**: predictable structure, clear instructions, minimal clutter, optional quiet reflection time

Barriers to Participation

- Technical jargon without scaffolding
- Assumption of uniform prior knowledge
- Heavy reliance on one modality (e.g. dense text or fast lectures only)
- Scheduling inflexibility for shift workers, parents, part-time learners
- Physical or digital environments that are not accessible

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Participation & Reflection

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Participation

Choose one hydrogen topic (e.g. storage, fuel cells, electrolyzer, sustainability) and take 5 minutes to formulate rough teaching strategies and their hurdles for two different target groups using these focus points:

- Prior knowledge to activate
- Likely misconceptions
- Teaching approach for each group
- Accessibility considerations and potential barriers

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Let's Hear Your Ideas

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Reflection & Closing

What we covered:

- Varying needs for different learner groups
- Adjusting one concept in different ways to accommodate those learner groups
- Universal Design for Learning: representation, action & engagement
- The importance of accessibility options

What we are leaving you with:

- What one change (at least) can you implement into your next teaching session?

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Feedback Survey

Thank you

Loredana Tiedke
loredana.tiedke@hs-bochum.de

Surya Devarajan
surya.devarajan@hs-bochum.de

Semih Severengiz
semih.severengiz@hs-bochum.de

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Bibliography

- CAST. (2018). *Universal Design for Learning (UDL): A framework for inclusive education.* https://www.cast.org/impact/universal-design-for-learning-udl
- Douvartzides, S. L., & H2VE Consortium. (2025). H2VE D5.1: Educational training material specification document (Version 01). PANEPISTIMIO DYTIKIS MAKEDONIAS. https://h2ve-project.eu/deliverables
- European Industrial Gases Association. (2020). Doc 75/20: Hydrogen safety guidelines. EIGA. https://www.eiga.eu
- Green Skills for Hydrogen Consortium. (2023). D2.2: Skills strategy (02-11-2023). https://greenskillsforhydrogen.eu/wp-content/uploads/2023/11/D2.2-Skills-Strategy-02-11-2023.pdf
- Green Skills for Hydrogen Consortium. (2024). D3.1: Hydrogen skills core VET curriculum. https://greenskillsforhydrogen.eu/wp-content/uploads/2024/03/D3.1-Green-Skills-for-Hydrogen-Hydrogen-Skills-Core-VET-Curriculum.pdf
- GTI Energy. (2025). Hydrogen training overview. https://www.gti.energy/training-events/training-overview/hydrogen-training/
- H2Excellence Project. (2025). Green hydrogen & fuel cell training. https://h2excellence.eu
- HYDEX Project. (2023). Skills gap evaluation in the hydrogen economy. https://hydex.ac.uk/wp-content/uploads/2023/03/Skills-Survey-Written-Report-Feb-2023.pdf

Bibliography

- HYPROFESSIONALS Project. (2013). Development of educational programmes and training for hydrogen professionals (Final report). European Commission, CORDIS. https://cordis.europa.eu/project/id/256758/reporting
- HyResponder Project. (2025). The impact of HyResponder on training across Europe. International Journal of Hydrogen Energy. https://doi.org/10.1016/j.ijhydene.2025.XXXXX
- HySkills Project. (2022). Skills requirement assessment IO1-T1-3 & implementation handbook. https://hyskills.org/wp-content/uploads/2023/08/Implementation-Handbook.pdf
- Hydrogen Skills Alliance & Cogent Skills. (2024). Hydrogen workforce assessment: Executive summary. https://cogentskills.com/wp-content/uploads/2024/07/Hydrogen-Workforce-Assessment-Executive-Summaryfinal.pdf
- International Renewable Energy Agency. (2023). Global hydrogen trade: Combustion vs. electrochemical pathways. IRENA.
- Murray-Smith, David. (2019). A Review of Developments in Electrical Battery, Fuel Cell and Energy Recovery Systems for Railway Applications A Report for the Scottish Association for Public Transport. 10.13140/RG.2.2.16555.67362.
- U.S. Department of Energy, Fuel Cell Technologies Office. (2024). Fuel cell basics. https://www.energy.gov/eere/fuelcells/fuel-cells
- U.S. Department of Energy. (2015). National hydrogen safety training resource for emergency responders (Barilo, C., presenter). https://www.energy.gov/eere/fuelcells/webinar-national-hydrogen-safety-training-resource-emergency-responders