Didactic and methodological notes for:

Module 4: Troubleshooting – a costumer reports a cold room:

Qualification requirements		
Plant mechanic for sanitary, heating and air conditioning systems	**Electronics technician – specializing in energy and building technology**	**Roofer, Window maker, drywall builder and similar branches**
Knowledge, skills and competences about: • Basics of the structure and the function of a gas heating system • Basics of controlling systems for heating • Safety rules and their own profession regulations	**Knowledge, skills and competences about**: • Basics of electric power supply of devices and systems • Basics of measuring current and voltage • Basics of the functioning of sensors for temperature measurements • Safety rules and their own profession regulations	**Knowledge, skills and competences about**: • Basics of wall, floor and ceiling insulation and possible failures of the insulation • Basics of the installation and sealing of windows and doors and the possible failures • Safety rules and their own profession regulations

Competences from all professions that could be relevant to solving the problem

- Systematic and structured approach in the search for the cause of the error
- The ability of formulate suitable questions for the customer in order to find the error as quickly as possible
- The ability to communicate professionally and to exchange information with employees from other trades

Enlargement of qualification requirements from areas that were previously unrelated to the field?

Plant mechanic for sanitary, heating and air conditioning systems

- Structure of the insulation of the outer wall, ceiling and floor
- Possible sources of errors in insulation; thermal bridges etc.
- Professional sealing of windows and doors and possible sources of faults
- Checking the power supply to the heating system
- Checking the temperature control

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Electronics technician – specializing in energy and building technology

- Structure of the insulation of the outer wall, ceiling and floor
- Possible sources of errors in insulation; thermal bridges etc.
- Professional sealing of windows and doors and possible sources of faults
- Components of a gas heating system and their importance for the operation of the heating circuit
- Adjusting and checking the function of a thermostatic valve and replacing the thermostatic head
- Professional venting of a heating system
- Filling the water in the heating circuit correctly

Roofer, Window maker, drywall builder and similar branches

- Components of a gas heating system and their importance for the operation of the heating circuit
- Adjusting and checking the function of a thermostatic valve and replacing the thermostatic head
- Professional venting of a heating system
- Filling the water in the heating circuit correctly
- Checking the power supply to the heating system
- Checking the temperature control

Goals and learning setting

The module is suitable for:

- Plant mechanic for sanitary, heating and air conditioning systems
- Electronics technician – specializing in energy and building technology
- Roofer, Window maker, drywall builder and similar branches

The learning objectives are:

- Systematic troubleshooting using the example of the ‘cold room’ problem (collection of all possible sources of error and creation of a process plan for systematic troubleshooting) Apply building science principles to thermal comfort problems
- Targeted communication with the customer to quickly identify the fault(s)
- Professional communication with employees from other trades
- Professional documentation of the results and solutions

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Number of lessons:

7 to 12 h

Depending on how deeply the structure and function of a heating system and the insulation of the building envelope are dealt with and to what extent the trainees are competent in using tools for brainstorming and creating a flow chart.

Learning setting:

A project day on which trainees from different trades work on the problem in mixed groups is an optimal setting.

It is also possible to integrate the learning situation into regular lessons spread over several weeks. Here too, it is helpful to mix trainees from different trades in working groups, if possible, to organize.

Competence profile related to the VQTS-Matrix			
Competence areas	**Competence devolpment steps**	**Level**	**Interdisciplinary / cross-disciplinary competences**
2: Maintain building systems or their componets	He/she can carry out complex inspection, maintenance and repair work on building systems and prepare documentation.	4	Trainees can identify causes of errors across different trades. The trainees know the limits of their own abilities and know when it is necessary to seek professional help from other trades.
8: Communication across trades, also in foreign languages	He/she can understand and use technical terms from his/her own and other trades.	4	Trainees are familiar with technical terms used in other building services engineering professions and can use them correctly when communicating with employees from other trades.

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Competence profile related to the matrix for sustainable thinking and acting	
Sustainable Development Fields in VET	Competence devolpment steps
Energy efficiency practices: encompasses knowledge and application of techniques to reduce energy consumption and promote practices that optimise efficiency and reduce waste.	He/she identifies opportunities for improving energy efficiency in projects and implements them in his/her work.

Where can the module be implemented in your national curriculum?	
Country	**Curriculum**
Italy	The module can be used in the 'Automation' course within the subject 'Renewable Energy Sources' in the fourth year of the program. After a brief presentation of the scenario, it can be also used in the 'Systems and Networks' course, in the 'Computer Science' track, during the fourth year.
Germany	• The module could be implemented in a vocational school during the third year in the Dual System. • This module is suitable for the dual vocational training system (Duale Ausbildung) • Occupation Electronics technician – specialising in energy and building technology • Plant mechanic for sanitary, heating and air conditioning systems “Rahmenlehrplan Anlagenmechaniker/-in SHK Lernfeld 7” -> Installation of heat distribution systems
Spain	• The module can be used in "Heat Producing Installations" in the subject "Assembly and maintenance of heating installations".

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Training plan			
Title of the lessons / individual units	**Competences**	**Duration / volume in training hours**	**Comments**
Introduction to the learning situation	The trainees analyse the task, describe the customer's problem and develop a solution strategy.	1h	Discuss the scenario and the problem described therein with the trainees. The scenario can be given to the trainees as a text or PDF document, but it can also take the form of a role play between a customer and a tradesperson, for example. Define the products to be created by the end of the learning situation. These are: • Product 1: graphical representation of possible causes of errors, e.g. as a mind map. • Product 2: graphical representation of a structured approach to troubleshooting, e.g. in the form of a flow chart. Divide the trainees into working groups, preferably across different trades.
Brainstorming: possible causes	Die Auszubildenden beschreiben mögliche Ursachen für den kalten Raum.	2-4 h	The trainees collect possible causes of errors for their working groups based on their previous professional

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

for the cold room	Die Auszubildenden dokumentieren die möglichen Ursachen strukturiert in Form einer übersichtlichen Grafik.		experience and using the materials provided. The results of their work are documented using a suitable tool, e.g. a mind map programme. Optional (if the trainees are not familiar with documenting brainstorming sessions using mind maps): Presentation of the mind map using a suitable example. Materials: • 02a-Information Heating systems.docx • 02b-tasks-Heatingsystems-blanc.docx • 02b-sample-solution-tasks-Heatingsystems-blanc.docx
Presentation of work results (product 1, mind map)	The trainees assess and supplement the work results of the other groups. .	1-2 h	The mind maps are presented to each other, e.g. as a presentation or a gallery walk. Missing aspects are added by the trainees or the teacher. Material: • 04-mindmap-v2-example-eng.docx • 04-mindmap-v2-example-eng.mm
Structured troubleshooting	The trainees describe a structured approach to determining the cause of	2-4 h	Description and graphical representation of a systematic and structured error cause to identify the possible cause of

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

	the failture in the form of a clear diagram.		the cold room, e.g. as a flow chart. Optional (if the trainees are not familiar with the schematic representation of troubleshooting using a flow chart): Presentation of a flow chart using a suitable example.
Presentation of work results (product 2, flow chart)	The trainees discuss and evaluate the work results of the other groups.	1-2 h	The flowcharts are presented, e.g. as a gallery walk. The different approaches developed by the groups are discussed by the trainees and evaluated according to the following criteria: • Complete? • Logical? • Effective? Material: • 05-Flowchart-troubleshooting-example-eng.pdf • 05-Flowchart-troubleshooting-example-eng.vsdx
evaluation		10 min	Online evaluation using suitable tools such as Forms

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.