Scenario 3: ***Advanced approach*** (Elicited/Open Inquiry)

In the Open inquiry the teacher takes the delicate role of defining the context for inquiry by presenting a multidisciplinary view of a theoretical problem or a real-life phenomenon. Subsequently, he/she stimulates the students to define their relevant questions, design and carry out their independent investigations, construct coherent explanations, communicate and share their results. An open inquiry-based instruction seems more efficient to reinforce learners' reasoning skills, also increasing the awareness of the process of scientific inquiry. Despite this, students involved in open inquiry may develop feelings of frustration due to the lack of achieving the desired goals independently from teacher's hints.

In the Elicited/Open inquiry level, within the microMOOC the teacher will provide students with only the research question, stimulating the learners to explore the potentialities of the remote/virtual lab by themselves. Here, the students design the procedure (method) to be followed in the use of the remote/virtual labs, record and interpret data, test their questions and share the findings. Although teachers are less instructive, they provide a framework (scaffolding) for the process when needed, prepare resource lists or help cards in order to help students to manage this level of inquiry. The students by mean of the microMOOC will be involved in a learning path with a specific process of activation — Elicited Inquiry—, consisting of a learning environment in which the instructor actively will participate to the debate on the physics governing the observed experimental findings, never providing exhaustive explanations to the students, but giving comments and hints, sometimes expressly incorrect, always leaving the students in a state of uncertainty, stimulating their reasoning and activating their scientific inquiry.

Main student outcomes: Through self-designed or stimulated exploration students make hypotheses, test their own predictions, and draw their own conclusions; they should reach higher levels of autonomy and develop higher-order thinking skills.

Recipe for the microMOOC realization (with an example):

STEM Laboratories: https://phet.colorado.edu/en/simulation/legacy/faraday - virtual laboratory, needs upload java applet on personal device

"Electromagnetic Induction": http://kdt-20.karlov.mff.cuni.cz/ovladani_2_en.html - remote lab

Faraday's Law: https://phet.colorado.edu/en/simulation/faradays-law - virtual laboratory, html

STEP 1: *Engagement* –

Teacher: introduces the students to interesting phenomena related to the topic to be explored (Electromagnetic induction) in order to stimulate curiosity. These phenomena should be appealing from many points of view as, for example, a famous experiment (historical interest) or a new frontier exploration or discovery, or a new technology for medical applications. In this phase the teachers should use videos or photos supporting student engagement, but they do not provide any explanation of the phenomena under analysis.

Students: are stimulated to find reasonable explanations of the observed phenomena, making connections among the existing knowledge and defining relevant questions about the topic (electromagnetic induction in real life) .

STEP 2: *Exploration* –

Teacher: provides the students with only the research question and stimulates the learners to explore the potentialities of two or more different remote/virtual labs. Here, the teacher shows to the students the basic properties of the proposed labs, letting them free to plan and perform their own exploration, but preparing resource lists or help cards in order to help students to manage this level of inquiry.

Students: plan the exploration, design the procedure (method) to be followed in the use of the remote/virtual labs and carry out their independent investigations. They search for information, raise questions, develop hypotheses to test, record and collect data

STEP 3: *Explanation* –

Teacher: actively participates to the debate on the physics governing the observed experimental findings, never providing exhaustive explanations to the students, but giving comments and hints, sometimes expressly incorrect, always leaving the students in a state of uncertainty, stimulating their reasoning and activating their scientific inquiry.

Students: by working individually or in group, generate coherent explanations supported by the data collected by the exploration of the remote/virtual labs, test their own predictions, and draw their own conclusions. They are responsible for uncovering the answers.

STEP 4: *Extension* –

Teacher: stimulates students to explore again the proposed laboratories in class or at home looking for different variables or different relationships; suggest to students to plan self-designed exploration by using materials available in the classroom.

Students: explore the electromagnetic induction, building possible generalizations. Create a scientific report (individual or for groups) about the work done and the reinforced concepts.

STEP 5: *Evaluation* –

Teacher: determines how much learning and understanding has taken place at the end of the learning experience by means of exercises, evaluation tests etc.

Student assignment: peer review of the reports.