Enhancing Learning in Teaching via e-inquiries

Intellectual Output 4

Sample digital scenarios for STEM teachers' competence development via inquiry methodology

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Intellectual Output:	O4: Sample digital scenarios for STEM teachers' competence development via inquiry methodology
Output description:	This document is concerned with the ELITe's project "Learning in teaching via e-inquiries" approach, as developed and operationalized in the form of sample digital scenarios under inquiry methodology - proposed to be used for STEM teachers' professional learning (PL) activities. The document: provides an overview of the ELITe's PL approach; presents how the approach has been developed; exemplifies how it has been applied for building the digital scenarios for the PL activities and provides an overview of the digital scenarios per country. The document accompanies the ELITe project O4, which is an interactive resource - consisting of 8 digital scenarios for STEM teachers PL activities per national context and related to them informative materials (available in http://www.learning-in-teaching.eu/index.php/en/intellectual-outputs/io4)
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Background and goals

The need to strengthen teachers' competences so as to respond to the demands of the new digital era is imperative. Teaching in the 21st century is more than a task bounded in classroom frames and it demands more than the acquisition of content and pedagogical knowledge and technical skills. Teachers nowadays need the competence to innovate and adapt in the opportunities emerging from the new digital era. This includes having critical, evidence-based attitudes to available resources, enabling them to respond to students' outcomes, evaluating new evidence from inside and outside classrooms and engaging in professional dialogue, in order to adapt their own practice for better students' learning outcomes (European Commission, 2013). Teachers, therefore, need to be supported in their new role as reflective practitioners, responsible for their own learning.

Science, Technology, Engineering and Mathematics (STEM) teachers' professional development, in particular, has been a prevailing area of current policy discourse focus. STEM education is considered vital in acquiring and developing competences needed for the 21st century, among others being: *ways of thinking* - creativity, critical thinking, problem solving, decision making; *ways of working* -communication, collaboration; *tools for working* -including new technologies; *capacities* –related to active citizenship, life and professional careers (OECD, 2011). More than ever before STEM teachers face the challenging role to facilitate students to '*acquire the necessary knowledge of and about science to participate actively and responsibly in, with and for society, successfully throughout their lives*' (EC, 2015).

In the course of these developments, ***the ERASMUS+ project ELITe develops an innovative approach for STEM teachers professional learning (PL) -"Learning in Teaching via e-inquiries" - aiming to support STEM teachers' learning for competence development, articulated in knowledge and understanding, skills, and dispositions and attitudes.*** The implementation and the evaluation of PL activities under the developed approach in the ***national contexts of Greece, the Netherlands, Bulgaria and Spain*** aim to facilitate the development of an evidence-based framework for teachers' competence development via inquiry methodology - which is one of the tangible outcomes of the ELITe project. The framework is to be proposed to the secondary school teachers' continuous professional development institutions as a good practice model, which they could use in the design of STEM teachers' training curricula.

This document is concerned with the ELITe's project "Learning in teaching via e-inquiries" approach, as developed and operationalized in the form of sample digital scenarios under inquiry methodology - proposed to be used for STEM teachers' PL activities. The document:

- provides an overview of the ELITe's PL approach;
- presents how the approach has been developed;
- exemplifies how it has been applied for building the digital scenarios for the PL activities and
- provides an overview of the digital scenarios per country.

The document accompanies the ELITe project IO4, which is an interactive resource - consisting of 8 digital scenarios for STEM teachers PL activities per national context and related to them informative materials (available in http://www.learning-in-teaching.eu/index.php/en/intellectual-outputs/io4). The utility of the document come to serve two purposes: from an operational perspective, to facilitate the process of implementation of the scenarios and extracting the evaluation data; from a conceptual perspective, to inform the development of teachers' handbooks (O6) provisioning the teachers with relevant information and good practices examples for facilitating changing practice, and, as a consequence – the development of framework for STEM teachers' competence development under an inquiry approach.

Overview of the "Learning in teaching via e-inquiries" approach

The "***Learning in Teaching via e-inquiries"*** approach for STEM teachers' professional learning ***steps on the principle that the teacher teaches in such a way in which he/she was taught.*** Inquiry-based learning (IBL) has been identified as one on the powerful innovative teaching approach, providing opportunities to develop the scientific literacy of all learners. In the same time, teachers meet difficulties to implement it in the classroom, due to missing experience in it, as, usually, the teachers' professional development courses are conducted in a traditional way via lectures. ***The main assumption of the ELITe project is that the implementation of the IBL methodology in teachers' competence development courses will provide them with real situation experience and know-how as well as with a reflection from 'students' point of view'***. Something more – the IBL has a very poor explored potential as ***an effective teacher training method, which can contribute for effective STEM teachers' competence development***.

Challenges and implicit requirements

The ELITe's approach is informed by current challenges and the aligned to them implicit requirements on STEM teachers' professional learning for competence development, outlined here below:

Table 1 ELITe approach challenges & requirements

		Challenges	***Implicit requirements***
Perspectives	Contextual	Variation in terms of teacher competence requirements among and within EU countries	Place-based approach, taking into consideration national policy requirements and practice needs
	Methodological	Teachers' practice is influenced by the way they have received training themselves	Modernization of teacher training methodology
	Content related	Thematic that facilitates addressing STEM broader aims	Relevance of the thematic to STEM broader educational aims
	Outcome related	Need for more rigorous evidence of the impact of competence based frameworks on teachers professional learning	Need for evidence-based framework for STEM teachers competence development

Main elements of the approach

On the basis of the above-mentioned challenges and implicit requirements, the ELITe project's approach for STEM teachers' PL bears the following elements, which should be interpreted as assumptions underpinning our approach.

The ELITe project's ***Learning in Teaching via e-inquiries*** approach for STEM teachers' competence development:

- *adopts a **place-based approach** for STEM teachers' professional learning, taking into consideration national policy requirements and practice needs*

  According to EC (2013) report conclusions, "teacher competence frameworks, when devised and implemented in ways that are relevant to each national context and consistent with other educational policies, can be powerful tools to improve educational quality" (p.43). In addition, "CPD provisions should respond to each teacher's specific needs", while among the key factors in the

successful development and implementation of a competence approach to teaching is "the process of bringing stakeholders discussing these issues (…) especially if it leads to an increased sense of ownership of the results" (p.43).

- *propagates the **adoption of the inquiry-based learning (IBL) methodology in professional learning activities**, under the assumption that STEM teachers' training via IB methodology supports the development of teacher competences*
  Good practice increasingly views both teachers and students as lifelong learners: teachers should in the same time '*learn how to teach*' and '*teach how to learn'*. IBL has long been recognized in science learning as a successful and promising approach for achieving science education goals - see for example "Science Education: A renewed pedagogy for the Future in Europe" (EC, 2007). In recognizing the qualities of IBL as a means of promoting better engagement and motivation in STEM subjects and skills development, we also need to recognize its effectiveness in teachers' professional development. In this context, in order to support STEM teachers' professional learning, we advocate the need to apply to teachers the same principles of learning as they are expected to employ with their students. Our approach ("Learning in Teaching via e-inquiries") foresees teachers' learning activities taking place through an online platform embedded on an IBL model (developed in the frame of the weSPOT project) which support personal and collaborative inquiry learning

- *proposes as thematic for STEM teachers' professional learning **content areas that reflect current policy orientation on the broader aims of STEM education**, so as to facilitate teachers to model key competences required (knowledge, skills and attitudes) in order to help students acquire them*
  STEM teachers need to be supported to meet current STEM education challenges and aims. The new STEM education imperative is to ensure that – on the one hand - future citizens have a better understanding of science and technology (if they are to participate actively in informed decision-making and knowledge-based innovation), and – on the other hand – future researchers are equipped with the necessary knowledge and tools to fully participate in and take responsibility for the processes of research and innovation (European Commission, 2015). STEM teachers, therefore, need to strengthen their competences to meet the challenge of ensuring that all students are scientific literate, able to apply science knowledge to improve their own lives, deal with an increasingly complex technological world and making science-related decisions as responsible citizens (European Commission, 2015).

- *Is oriented towards facilitating the development of **an evidence-based framework** for teacher's competence development through IBL methodology*
  Teacher training activities under the "Learning in Teaching via e-inquiries" approach aim to provide evidence for the development of the main tangible outcome of the project, namely an evidence-based framework for STEM teachers' competence development via inquiry methodology - aiming to inform curriculum design for STEM secondary teachers' continuous professional development and learning

Methodology for building the approach

The process of the development of the "Learning in teaching via e-Inquiries" approach for STEM teachers' competence development was initiated with the first project phase (Preparation), which aimed at: reviewing the national context and the national policy requirements in four European countries - Greece, the Netherlands, Bulgaria and Spain (documented in O1); identifying indicators for evaluating STEM teachers' competence development (documented in O2); and identifying the main barriers and opportunities in STEM teachers' competence development (documented in O3) . The goal of the second project phase (Development) is to develop the ELITe's learning in teaching approach via e-inquires, an adaptation of inquiry methodology for teachers' competence development, taking into consideration results and insights obtained during the preparation phase.

Information of the key processes to build the ELITe project's ***Learning in teaching approach via e-inquiries*** is detailed here below. Key processes are structured and implemented around the questions:

1. ***In what context?***
2. ***What for?***
3. ***Which content areas?***

4. ***How to structure and implement?***
5. ***How to ensure evidence on the value?***

For each key process, outlined are: the objectives, the methodology followed to achieve the objectives and the results of previous work conducted in the frame of ELITe project (as well as the weSPOT project) that served as input for building our PL approach.

KEY PROCESS 1 – IN WHAT CONTEXT?		
Objectives	**Methodology**	**Input for building the PL approach**
To identify: • national policy priorities and actual practice • systemic opportunities and challenges on/for STEM teachers competence development in the national contexts of Greece, the Netherlands, Bulgaria and Spain	• Documentary analysis of national policy documents, STEM teachers training curricula, STEM students curricula under the EC (2013) framework for teachers' competence development • Negotiation with educational stakeholders in national workshops under the EASW methodology	• Requirements for STEM teachers' competences (knowledge & understanding, skills, dispositions & attitudes) as evident explicitly in policy documents and teacher training curricula and implicitly in students STEM curricula in Greece, the Netherlands, Bulgaria and Spain (documented in IO1) • Systemic opportunities and challenges for implemented PL activities for STEM teachers competence development in Greece, the Netherlands, Bulgaria and Spain (documented in IO3)

KEY PROCESS 2 – WHAT FOR?		
Objectives	**Methodology**	**Input for building our PL approach**
• To define the expected outcomes of the PL approach • To define indicators for evaluating the expected outcomes	Clustering aspects of teachers' competences (knowledge, skills and attitudes) of the EC (2013) framework for teachers' competence development into groups of expected outcomes Translating aspects of competences of the EC (2013) framework for teachers' competence development into indicators and sub indicators for evaluating the expected outcomes	Definition of: • expected outcomes • indicators and sub-indicators relevant to the national contexts of Greece, the Netherlands, Bulgaria & Spain for evaluating the ELITe's learning in teaching activities (documented in IO2)

KEY PROCESS 3 – WHICH CONTENT AREAS?		
Objectives	**Methodology**	**Input for building our PL approach**
To identify content areas for the PL activities most relevant for each national context	• Review of recent large scale surveys ((OECD), Teaching and Learning International Survey TALIS 2013, Conceptual Framework, 2013), ((OECD), Teaching and Learning International Survey TALIS 2018, Brochure, 2018)) which offers an interesting insights into secondary teachers' self-perception of needs and participation in continuous professional development (CPD) • Negotiation with educational stakeholders in national workshops under the EASW methodology on content areas most relevant to each national context	Content areas for the PL activities most relevant for each national context (documented in IO3)

KEY PROCESS 4 – HOW TO STRUCTURE & IMPLEMENT?		
Objectives	**Methodology**	**Input for building our PL approach**
• To define the methodological steps of the PL activities • To identify the recourses needed • To produce an implementation plan	• Adaptation of the weSPOT IBL model for teachers' professional learning activities • To review available OER (Open education Resources) • Detailed implememation plan	• The weSPOT IBL model (documented in the weSPOT project's deliverable D2.4) • OER available on the web

KEY PROCESS 5 – HOW TO ENSURE EVIDENCE ON THE VALUE?		
Objectives	**Methodology**	**Input for building our PL approach**
• To clarify what we want to learn by implementing and evaluating the PL activities • To align the development of the approach with the requirements of future project work	Orientation towards facilitating data gathering for subsequent project work relating to the added value	• Requirements of the evaluation framework- research questions to be (documented in IO2) • Requirements for developing IO4 • Requirements for developing IO8

Methodology for structuring scenarios that support the approach

The scenarios development methodology is process-objectives oriented in correspondence with the ELITe project methodology. It follows a continual improvement approach that involves development, reviewing, implementing, evaluating & improvement of the teachers' competence development scenarios. Each scenario can be conducted as a separate teachers' competence development course or as a module of a more complex continuous professional development course. The process of each particular scenario development lays on the results of building *Learning in teaching via e-inquiry* approach. Tasks leading to the production of IO4 modules' scenarios are:

- Selection of the evident-based content areas / topic, most relevant to each national educational context, based on IO1 and IO3 (in correspondence with *Key process 1*).
- Defining the module's objectives in terms of IO2 results (in correspondence with *Key process 2*).
- Selection of inquiry skill leading to the specific teachers competence development, based on IO2 (in correspondence with *Key process 2*)
- Selection of the particular content areas, based on IO3 (in correspondence with *Key process 3*)
- Defining the expected learning outcomes
- Structuring the learning activities under the weSPOT IBL model (in correspondence with *Key process 4* and selected inquiry skills to be developed)
- Selection of the assessment methods and tools (in correspondence with *Key process 5*)
- Selection of relevant and appropriate learning materials according to the particular content area and specific target group
- Structuring the e-learning content and tools in correspondence with e-learning activities and assessment methods

The last step is development of a brochure outlining each scenario for dissemination purposes.

Overview of the digital scenarios in the four countries

Thematic areas

The ELITe project scenarios for STEM teachers' professional learning correspond to ***thematic areas*** relating to current challenges for STEM professional teaching and learning, outlined here below:

- Dealing with inclusion and diversity
- Teaching STEM for skill development
- Incorporating RRI in STEM education
- Innovative STEM methodologies (IBL & project work, self-directed learning, computational thinking)
- Opening up school science
- Assessment challenges in STEM
- ICT enhanced STEM learning and teaching
- Confronting challenges of new curricula
- Enhancing teachers-parents collaboration

Input for the selection of the thematic areas has been provided by a) the national requirements for STEM teachers' professional development (documented in IO1) and b) the identified opportunities and challenges for STEM teachers' competence development in the four countries that will implement training activities in the project (documented in IO3).

Thematic map of the scenarios

The chosen thematic areas by each country show common problems and *gaps* in STEM teachers' professional development in different countries, as they are listed in the table below:

Table 2 Map of the common topics of interests

Thematic areas / Country	**Scenarios in each thematic areas in the national contexts of**			
	GR	**NL**	**BG**	**ES**
Inclusion and diversity	Reflective practice for tackling inclusion and diversity issues in STEM classrooms		***Neither sees nor hears, but succeeds*** /researchers with SEN in school/ Creating a learning design for successful learning through Inquiry based learning approach of pupils with SEN	Dealing with diversity in education: gender differences, learning styles, personalisation,etc.

Teaching STEM for skills development	Promoting students' achievement in STEM: Changing perspectives from knowledge acquisition to skills development	Learning to design Inquiry-based learning with DojoIBL: an exploration		Design of good IBL activities based on DojoIBL for teaching and learning
RRI in STEM education	Dealing with controversial socio-scientific issues in contemporary science			Strategies for introducing socio-scientific issues in the classroom: dilemmas, controversies, conversations.
Innovative STEM methodologies (IBL & project work, self-directed learning, computational thinking)	Design and delivery of an interdisciplinary STEM project	Self-directed learning for professionals in Education. An online master-class for teacher, teacher educators and students of master of science in Educational Science interested in the topic of self-directed learning Computational thinking in the (STEM) classroom and beyond	***Detectives in the classroom*** IBL approach in STEM discipline (how to design, deliver, conduct and evaluate IBL education in STEM)	Overcoming key difficulties of Inquiry Based Learning for STEM teachers
Opening up the STEM classroom	Opening-up science education: Taking advantage of the potential of informal science education	Learning and teaching in a seamless way (combining classroom learning with learning in the outside world: an introduction (**part 1**) and designing seamless learning experiences (**part 2**)	***Open air lessons – myth or not…*** Design of the open air field IBL education in STEM	Approaching STEM in collaboration with scientific centres, and science museums and other other local institutions.

Assessment challenges in STEM	Confronting challenges on IBL from implementation and assessment perspectives	Assessment of 21 century skills with technology: how do you do that in practice? Viewbrics, a tool for assessment of 21st century skills	***Measure three times, cut once:*** Assessment for success (methods, techniques and tools for assessment IBL project work and team work)	
ICT enhanced STEM learning and teaching		Challenges of Inquiry based learning and how to tackle them using DojoIBL. A design-oriented course for teachers of secondary vocational education (in STEM related domains)	***Dream or Reality***: Combining "dreams" (online tools, virtual reality, augmented reality and others) and "reality" (real places for educational visits	Emerging ICT technologies in STEM education: computational thinking, robotics, and game-based learning Open Science resources: use , adaptation and design of digital resources for the STEM classroom.
Confronting challenges of new curricula			***The challenges in the new ICT curriculum for 8-th grade*** The scenario is dedicated to familiarize trainees with new challenges there and to prepare them for teaching under its framework	
Enhancing teachers-parents collaboration	Overcoming personal bad experiences of parents for STEM success of their children			
	Supporting gender-neutral approaches to STEM at home			

The mapping of the scenarios thematic areas outlined common issues in teachers' professional development which became a base for collaborative discussions about the weak competences, their origin and how they are presented in different countries. The result is development of teachers training ELITe scenarios, having touching points but reflecting the specific audience, needs and situation in each country.

Taking a more general look, the mapping table is a base for formulating assumption that they are European wide issues, related to the STEM teachers' professional development, to which solving the ELITe project can successfully contribute. Even more, as the scenarios deals with complex issues, detailed elaboration of the scenarios' objective, goals and workflow are able to outline much more common issues among participating countries although the difference in policy documents and experience.

Overview of the scenarios per country

In correspondence with main thematic areas outlined, each country has outlined the topics of 8 national specific scenarios. Three of them are on general teaching learning thematic, three – of STEM related issues, and last two – on the teachers/parents related issues.

The 'teachers/parents scenarios' are prepared on the base of a general EPA's suggestions as it is the partner with special expertise in the area, relating of parents, and has data for each of the participating countries as well as for Europe at a whole.

The next overview presents the general and STEM teaching related scenarios, developed by countries as well as two shared basic 'teachers / parents' scenarios, which will be contextualized during the implementation phase.

Greece

General teaching / learning thematic	
Scenario Title	**Reflective practice for tackling inclusion and diversity issues - opportunities and challenges in STEM classrooms**
Rationale	Inclusion typically refers to the integration of children with special needs into mainstream schools and classrooms; however the idea of inclusive education in current discourse expands that concept to any child with varying abilities, who are at risk of school failure or dropping out, as well as from various minority groups and cultures. The challenge for inclusive education is of prominent relevance to the Greek context: Greek educators nowadays are asked to teach in increasingly multicultural classrooms as well as integrate students with special educational needs. STEM teachers in particular are called to deal with gender issues, among others being the different dispositions and attitudes on STEM subjects and STEM studies among boys and girls. This module aims to facilitate STEM teachers' reflective practice for tackling diversity issues in their classrooms and for addressing the challenge of inclusive education. Opportunities and challenges for dealing with inclusion specifically in STEM teaching and learning will be negotiated. Effective school practices and teaching approaches will be presented as examples of good practice and as a ground for reflection and inspiration for own practice.
Training objectives	This module aims to enhance teachers': • *knowledge* on teaching strategies for dealing with inclusion and diversity; • interpersonal *skills* and ability to adapt to educational contexts; • critical *attitudes* towards their own teaching practices and positive *dispositions* on promoting students democratic attitudes.
Learning outcomes	Having completed the course, participants are expected to be able to: • use research knowledge, and adopt/adapt good practices for dealing with the challenge of inclusive education in STEM classrooms;

	• demonstrate critical attitudes towards their own teaching practices – examining, discussing & questioning practices – in respect to inclusion and diversity issues
Scenario Title	**Promoting students achievement in STEM: Changing perspectives from knowledge acquisition to skills development**
Rationale	Recent and current Greek educational reforms are oriented towards students' skills acquisition. This is highly challenging for STEM teachers as it requires a shift from teaching scientific facts to equipping students with skills related to STEM subjects. The aim of this activity is facilitate STEM teachers' reflective practice towards the promotion of students' skills. What are 21st century skills need to be promoted? How can STEM teaching and learning facilitates the acquisition of 21st century skills? What are the challenges in Greek curricula & classrooms for teaching for skills acquisitions and how can be confronted?
Training objectives	This module aims to enhance STEM teachers': • Curricular knowledge on students skills that should be developed via STEM • Ability to adapt and assess teaching/learning objectives and processes • Positive dispositions towards change and flexibility
Learning outcomes	Having completed the course, participants are expected to be able to: • Identify the 21st century skills that could/should be developed via STEM studies • Prepare a lesson plan on a topic of the curriculum aiming to skills development rather than teaching scientific facts
Scenario Title	**Design and delivery of an interdisciplinary STEM project**
Rationale	Interdisciplinary projects are a part of current reform in secondary Greek education (both at lower and higher secondary levels). As an outcome of the Greek multiplier event, it became evident that STEM teachers need extra help both in managing project work and in dealing with interdisciplinary issues. In this activity STEM teachers will co-develop a project and will be facilitated in planning, managing and accessing project work
Training objectives	This activity aims to enhance STEM teachers': • Knowledge on methodologies and methods for planning, conducting and assessing an interdisciplinary project; • Interpersonal skills for learning in professional communities; • Epistemological awareness and dispositions to team working, collaboration and networking
Learning outcomes	Having completed the course, participants are expected to be able to: • adopt/adapt good practices & methodologies for planning and implementing an interdisciplinary project with fellow-teachers in their classrooms; • demonstrate epistemological awareness & positive dispositions to team working, collaboration and networking
STEM related issues	
Scenario Title	**Dealing with controversial socio-scientific issues in *contemporary science***
Rationale	Currently STEM teachers need to equip students for making sense of the cutting edge technology and science that affects our lives and understanding how scientific research is developed. This is highly challenging as it requires a shift from teaching scientific facts to equipping students to discuss socio-scientific issues by applying science knowledge, ethical values and inquiry skills. STEM teachers need to develop pedagogical know-how and practice to help learners to integrate science knowledge with ethical values for evidence-based thinking.
Training objectives	This activity aims to enhance STEM teachers': • pedagogical *knowledge* on teaching methodologies for dealing with socio-scientific issues in their classrooms; • *teaching skills* for learning through content

	• *dispositions* and *attitudes* on incorporating socio-scientific issues in classrooms
Learning outcomes	Having completed the course, participants are expected to be able to: • adopt/adapt good practices & methodologies for incorporating socio-scientific issues in their classrooms; • demonstrate critical attitudes towards their own teaching practices – examining, discussing & questioning practice
Scenario Title	**Confronting challenges on IBL from implementation and assessment perspectives**
Rationale	STEM teachers are often positive of the value of using IB learning; however many find it difficult to overcome the barriers for adopting this approach in their classrooms. In this module participants will reflect on and share experiences about the challenges they face when implementing IB in their classrooms. Central concepts of IB will be introduced, and resources on good practices for confronting IB learning and teaching challenges will be shared. Participants will be involved in hands-on activities on creating their own IB lesson/project in the Dojo-IBL platform and will reflect on how their learning experience has helped them to deal with the identified challenges for adopting IB approach.
Training objectives	This module aims to enhance STEM teachers': • pedagogical *knowledge* on IB learning and teaching and on new technologies as a tool for orchestration students' learning; • reflective and metacognitive *skills* on their teaching practices; • critical *attitudes* towards their own teaching and positive *dispositions* on adopting innovative teaching methodologies
Learning outcomes	Having completed the course, participants are expected to be able to: • use research knowledge, and adopt/adapt good practices for confronting IB challenges in their classrooms; • prepare the design – how to implement and how to assess - of an IB lesson in their subject with the use of new technologies • demonstrate critical attitudes towards their own teaching practices – examining, discussing & questioning practices
Scenario Title	**Opening-up school science education- taking advantage of the potential of informal science education**
Rationale	Learning in informal contexts is far from a new phenomenon. However, the way that it is happening has considerably changed during the last decades as a result of the potential of greater use of digital means in learning and teaching process – for example the increased availability of educational resources in the web. In this activity participants will share experiences on the ways in which they utilize informal learning resources and reflect on the criteria under which they chose the form of informal learning that in their classroom practices.
Training objectives	This activity aims to enhance STEM teachers': • *knowledge* on the potential of use of digital means for promoting students' learning; • *ability* to utilize informal science resources for professional decisions and teaching/learning improvement • *openness* and *flexibility* to new approaches and ideas
Learning outcomes	Having completed the course, participants are expected to be able to demonstrate ability to use effectively informal science resources for professional decisions and teaching/learning improvement

General teaching / learning thematic	
Scenario Title	**Self-directed learning for educators.**
Rationale	This scenario is designed in cooperation with representatives of teaching institute (Iselinge Hogeschool) because of the relevance of teaching self-directed and self-regulated learning skills to teachers
Training objectives	This scenario aims at enhancing teachers': • Knowledge of the concept and insights in the way the concepts of self-directed learning and self-regulated learning • Affinity with instruments for evaluating SDL and SRL skills in teachers • Openness and flexibility to new approaches and ideas • Critical attitudes to one's own teaching (examining, discussing, questioning practices) • Disposition to team-working, collaboration and networking • Reflective and metacognitive skills
Learning outcomes	Having completed this scenario participants will have a deep understanding of the concepts of SDL and SRL and the way they play a role in teacher professional learning. Participants have answered their specific learning questions and demonstrated their own skill development as self-directed learners.
Scenario Title	**Learning to design Inquiry-based learning with DojoIBL**
Rationale	Innovative teaching approaches such as inquiry-based learning, project or problem-based learning are part of current instructional practice, yet challenges remain manifold, both for (young) learners as for teachers. Teachers need to be aware of these challenges before they start IBL projects and they need to know how to tackle them effectively. Technologies can offer support but they need to be understood and used properly. Teachers not always have or take the time to explore the available tools before using IBL with students. This scenario aims at tackling these issues. It will combine an introduction to DojoIBL, a project management online tool that supports learners and teachers in IBL with an overview of basic principles of organizing and orchestrating learning according to inquiry-based methodology. Central concepts of IBL will be included and the implications for educational practice will be illustrated. Learners will experience working and learning on their individual or group IBL environments and get an in-depth understanding of the rationale of using particular components of DojoIBL for the purposes of inquiry-based learning.
Training objectives	This scenario aims at enhancing teachers': • understanding of and insights in learning and teaching according to IBL methodology; • understanding of and insights in technological affordances for the orchestration of learning according to IBL methodology; • instructional design skills and the use of technology for designing and orchestrating learning • reflective and metacognitive skills • critical attitudes to one's own teaching (examining, discussing, questioning practices)
Learning outcomes	Having completed the scenario participants will be able to use DojoIBL environment for designing and implementing their own project scenarios and explain underlying theoretical concepts of inquiry-based learning.
Scenario Title	**Assessment of 21 century skills with technology: how do you do that in practice? Viewbrics, a tool for assessment of 21st century skills**
Rationale	To successfully give good feedback, students and their teachers need to have an accurate idea of what these goals mean specifically. The expectations have to be formulated decently, in clear, not too difficult language. This can be done with the help of rubrics, guidelines used to communicate the learning expectations or learning standards that have to be reached by students within a certain amount of time. Not only do they help students with feedback, they also measure the

	extent to which a student masters a certain skill. This is why, in secondary education, rubrics are used more and more to support the learning process of complex (21st century) skills. This scenario will be an introduction of an online tool which includes rubrics in more than one format – textual descriptions and video models. The scenario targets teachers in different domains who integrate teaching disciplines (i.e., STEM-disciplines) with complex 21st century skills. The scenario will follow IBL methodology and will be offered with the help of DojoIBL.
Training objectives	**This scenario aims at enhancing teachers':** • Insights of the concept of formative learning (assessment for learning) of 21st century skills • Understanding of and insights in technological affordances of Viewbrics, a tool for assessment of 21st century skills; • Ability to critically reflect on the opportunities and challenges of using Viewbrics in classroom learning • Openness and flexibility to new approaches and ideas • Critical attitudes to one's own teaching (examining, discussing, questioning practices) • Disposition to team-working, collaboration and networking • Reflective and metacognitive skills
Learning outcomes	Having completed the scenario participants will have a general understanding of how Viewbrics online tool can support formative assessment and will have reflected on how this tool can be applied in their classroom practice.
STEM related issues	
Scenario Title	**Seamless Learning: connecting contexts for (STEM) education, scenario 1**
Rationale	The focus of this scenario is on the concept of seamless learning and the prerequisites of integrating seamless learning (projects) with formal school curricula and in STEM education, in particular. Learners (teachers, eg teachers in STEM-disciplines) will be introduced to the concept and will be invited to brainstorm and reflect on the added value, opportunities and challenges or barriers to linking classroom learning to learning in the real world. Connecting classroom learning to outside world learning and working together with a variety of partners on realizing seamless learning reflects the societal needs in new generation equipped with 21st century skills and competences. However, integrating real life experiences in classroom learning can be challenging and demand other skills and competences from the teachers that they may lack. Collaboration with specialists from a variety of disciplines is needed and instructional design skills may be needed. Foremost, teachers need to have an idea of what seamless learning entails and what opportunities it offers. Furthermore, they need to understand the possible challenges and be aware that effort might be needed in tackling them.
Training objectives	This scenario aims at enhancing teachers': • understanding of the concept of seamless learning • ability to critically reflect on the current classroom learning • collaboration and negotiation skills (optional) • openness and flexibility to new approaches and ideas • disposition to team-working, collaboration and networking
Learning outcomes	Having completed the scenario participants will • Demonstrate understanding of and insights in the concept of seamless learning by discussing the possibilities of and the barriers to organizing such projects in practice. • Demonstrate their ability to elaborate on new ideas and approaches to learning including the concept of seamless learning • Be able to proceed to the Designing Seamless Learning Experiences course which will be offered as a follow-up scenario
Scenario Title	**Inquiry based learning in secondary vocational education: A design-oriented course for teachers of secondary vocational education (in STEM related domains)**

Rationale	This scenario is directed at teachers and instructional designers in secondary vocational education who want to experiment with introducing inquiry learning in their curricula.
Training objectives	This scenario aims at • enhancing knowledge of and insights in learning and teaching according to the principles of inquiry learning in vocational education; • the basic knowledge of using technology for design of inquiry learning; • improving design skills around design and orchestration of inquiry learning in vocational education; • reflective learning and stimulating innovative behaviour of teachers in vocational education.
Learning outcomes	After completion of this scenario participants will have experienced inquiry learning for their own professional development and have reflected on the implications of introducing this approach in their curricula. Furthermore they have learned how to design and set up a learning environment in DojoIBL for their own course and will be able to justify and relate the choices made to the underlying principles of inquiry learning.
Scenario Title	**Computational thinking in the (STEM) classroom and beyo**nd
Rationale	Coding and computational thinking attract nowadays hundreds if not thousands of teachers from outside the domains of computer science. Why is it happening? Why are teachers from different disciplines eager to learn what computational thinking entails? What are the implications of this new development? What makes computational thinking a 21st century skill? What is specific about it? How does it affect classroom learning in general and learning and teaching in STEM disciplines in particular? These and some other questions form the focus of a short introduction to Computational Thinking and Coding in the Classroom scenario offered by the Open University Netherlands for teacher professional development. This course will follow the inquiry-based learning methodology, participants will use DojoIBL platform to choose questions that they find most interesting and answer these questions with expert support.
Training objectives	**This scenario aims at enhancing teachers':** • understanding of and insights in the concept of Computational Thinking and the basic concepts of Computer Science; • knowledge of the basic principles of Coding without using any programming language; • insights in the opportunities and main challenges of introducing Computational Thinking in the classroom • critical attitudes to one's own teaching (examining, discussing, questioning practices) • reflective and metacognitive skills
Learning outcomes	Having completed the scenario participants will have the basic knowledge and understanding of the principles underlying Computational Thinking and will be able to reflect on the opportunities and challenges of Computational Thinking and Coding in their own classroom practice.

Buglaria

General teaching / learning thematic	
Scenario Title	***"Dream" and Reality***
Rationale	The scenario deals with: • Promotion the variety of existing opportunities to combine "dreams" (online tools, virtual reality, augmented reality and others) and "reality" (real places for educational visits) and how both of them can enrich the learning process, increasing students' performance on the STEM disciplines.

	• Understand existing and new technologies and how they can enhance educational process. • Leave the classroom (outdoor lessons) and organize visits to scientific and research institutions where certain research experiments and demonstrations can take place. • Interdisciplinary training will be an outcome of the teachers' teamwork. Application of the IBL model to study nature requires more specific teachers' competences. • Challenges that teachers have to solve when they plan to organize outdoor lessons. Problems encountered in implementing technology-enhanced learning and in using new technologies in learning. • Advantages and disadvantages for learners and trainers in the "dream" and "reality" training scenarios.
Training objectives	Development of teacher's competences related to: • study and apply normative documents; • perform pedagogical research through IBL; • develop a design of "non-traditional" training. Improvement teachers' skills to: • plan, organize and assess students' activities; • know and use new technologies and apply them in class - to conduct technology-enhanced learning. Teachers will develop competences to organize and to conduct outdoor classes/lessons outside the school, in places relevant to the learning process. In the teamwork, each participant of the training should "experience" the learning outcomes that the pupils should reach.
Learning outcomes	After the training the participating teachers will be able to: • Prepare all the documents needed to be authorized to organize outdoor classes and visits in scientific institutions where specific research and demonstrations (observatory, planetarium) can take place; • Prepare a set of instructions for use of mobile devices in class for educational purposes. Design and implement an IBL lesson (or series of lessons), related to observation of objects and phenomena that can hardly be observed in class; • Develop a plan for scenario for conducting technology-enhanced lesson in class. Selection and description of required technologies (minimum technical requirements), availability of additional devices (as virtual reality glasses and others). • Organize, design and conduct outdoor training
Scenario Title	***Measure three times, cut once***
Rationale	The scientific approach and team work are relatively new methods applied in Bulgarian education. For this reason, there are no evaluation cards, evaluation criteria, and experience on the part of the teachers.
Training objectives	The participants will: • Acquire knowledge of various methods and means of assessment • Build skills to evaluate and adequately apply the proposed methods and tools (harnessing experience) • Form a positive attitude in assessing all achievements, results and individual growth • Develop motivation to create an evaluation card design
Learning outcomes	After completing the module the participants will be able to: • Adequately apply different assessment methods and tools in education based on the scientific approach • Apply correct evaluation of the achieved results and individual progress • Apply different forms and methods for assessment of team work and education based on scientific approach

Scenario Title	***Neither sees nor hears, but succeeds*** (researchers with SEN in school) Creating a learning design for successful learning through Inquiry based learning approach of pupils with SEN
Rationale	The success of every student with special educational needs (SEN) depends on the teacher's knowledge of specific requirements and limitations of the learners with SEN. Teachers have difficulties to organize the work of children with SEN and to involve them in Inquiry Based Learning (IBL), they have to know the legal framework and to possess specific knowledge and skills in order to be able to better integrate and involve these learners with different training needs in the IBL. Identification of the methods by which SEN learners can be effectively involved in the trainings applying the IBL approach.
Training objectives	Development of: • knowledge for the limitations and needs of learners with different types of SEN; • skills to apply different methods and tools for inclusion of SEN pupils in the IBL approach; • motivation to create a learning design, adapted to involve SEN learners in training based on IBL approach; • will know the different limitations and needs of the SEN learners; • will be able to apply different methods and tools to integrate SEN pupils into training using a IBL approach; • will be motivated to create a learning design, adapted to involve SEN learners in trainings based on IBL approach.
Learning outcomes	Completing the module, participants will be able to: • understand the specific difficulties of the more popular SEN issues • design the learning environment in correspondence with the needs of their students • design students activities that involve all students in learning process • react to the safety issues related to the SEN students during out-the-door activities.
STEM related issues	
Scenario Title	***Open air lessons – myth or not…***
Rationale	Teaching science, there is necessity of building common *picture* of the nature. It is natural this *picture* to be created in the nature. The interdisciplinary learning is integrated in the most science subject curricula, but there is not rich experience in working in teams of teachers and design of such education. In addition, applying the IBL model requires more specific teachers' competences. It is still difficult to organize outdoor lessons in Bulgaria – there is quite hard procedure and new set of normative documents, which should be prepared. To implement outdoor learning process, the STEM teachers need to develop competences to prepare such set of documents in accurate and efficient way. Open-air lessons by themselves are challenging for students and for teacher. The scenario is designed to support teachers to face these challenges.
Training objectives	This module aims are: • Familiarizing with normative documents related to organizing and delivery of open-air lessons. • Building skills to prepare the documentation, related to the outdoor education. • Motivating STEM teachers to organize and deliver outdoor lessons • Improvement teachers' skills to plan organize and assess students' activities during open-air IBL education. • Development of competences to design non-traditional lessons • Forming and development key teachers' competences for open-air (in natural environment) lessons delivery. • Development of team working competences

Learning outcomes	After the training the participating teachers will be able to: • Prepare all of the documents needed to be authorized for open-air learning; • Design open-air IBL interdisciplinary lessons on given topic; • Work in team with other STEM teachers in the school; and will experience what his students would like to reach.
Scenario Title	***Detectives in the classroom***
Rationale	The scientific method is fundamental to the development of modern sciences. That is why the teaching of these sciences should be inextricably linked to the application of the method. That would lead to the development of curiosity and research skills in the students.
Training objectives	To prepare the trainee to design of inquiry-based learning style of teaching science , to conduct and evaluate the results of such training. Development of: • Research competencies and confidence • Abilities to transfer research competencies and provoke curiosity • Skills to apply different methods and tools from the IBL approach • Motivation to apply the IBL approach in teaching practice.
Learning outcomes	After the training the participating teachers will be able to: • prepare a design of IBL in subject he/she teach • explore the ideas and experience of other trainees
Scenario Title	***The challenges in the new ICT curriculum for 8-th grade***
Rationale	During the educational reform in Bulgaria, there were developed new students' curricula in all disciplines. In 2017-2018 academic year, there start using the new curricula for 8-th grade. The Ministry of Education and Science organize the national large teachers' and teacher's educators' trainings in how to apply the new curricula in ICTs for 8-th grade, and the Sofia University is invited to provide them. The scenario is dedicated to familiarize trainees with new challenges there and to prepare them for teaching under its framework
Training objectives	The module aims development of: Knowledge on: • New concepts in the 8-th grade ICT curricula • Specialized new content in the 8-th grade ICT curricula • Use of Web 2.0 (cloud) applications for working in shared environment and development common documents in teams • Ethical issues when working with students in a cloud Skills for: • Preparation of technical teaching environment • Use of virtual machines for management of special students' tasks, required administrative rights on computers • Design and management of educational process working in a cloud • Design, management and assessment of students project in ICTs • Attitude to the modern ICTs used in life and the need of development students' competences to use them in ethical and creative way for life, learning, self-expression, entertainment, etc.
Learning outcomes	After the training the participating teachers' educators and teacher will: • Have clear understanding on similarities and main differences between previous and new ICT curricula for 8-th grade • Be able to install and setup a virtual machine as a technical environment for teaching special topics • Be more confident on knew topic – computer networks, mobile technologies, work in a cloud

	• Be more confident in innovative teaching methods as management project work in teams • Be able to train teachers of their regions how to teach the new ICT curricula to their students • Explore the ideas and experience of other trainees

Spain

General teaching / learning thematic	
Scenario Title	**Design of good IBL activities based on DojoIBL**
Rationale	This course is addressed to teachers who would like to learn the basic principles of organizing and orchestrating learning according to inquiry-based methodology. Central concepts of IBL will be included. Learners will be able to experience working and learning on their individual or group IBL environments using DojoIBL, a project management online learning environment free of charge. Further, they will obtain an in-depth understanding of the rationale of using particular components of DojoIBL for the purposes of inquiry-based learning.
Training objectives	A. Knowledge A1. Develop teachers' Pedagogical Knowledge in terms of underlying concepts belonging to STEM domains, insights in learning and teaching according to IBL methodology A2. Develop teachers' knowledge on new technologies and their affordances as a tool for more effective lesson planning *and orchestration of this learning* B. Skills B1. Carry out an inquiry to learn about designing an Inquiry-Based Learning lesson involving reflection on learning and exchange with peers B2. Plan, manage and coordinate an IBL lesson [in an online learning environment] C. Attitudes C1. Develop critical attitudes to one's own learning C2. Disposition to promote students' IBL skills as a useful way to participate in scientific and technological development C3. Transferrable skills
Learning outcomes	A1a. Suitable pedagogies for STEM teaching A1b. Phases of an IBL lesson A1c. Learning resources for IBL lessons A1d. Role of the teacher and the learner in an IBL lesson A2a. Principles of orchestration of learning A2b. Affordances and functionalities of DojoIBL B1a. Follow all the steps of the inquiry successfully B1b. Reflect on one's learning B1c. Interact with peers B2a. Select and use teaching materials and technology B2b. Configure student groups so to achieve learning outcomes B2c. Plan assessment strategies for an IBL scenario B2d. Plan a student feedback collection strategy to improve teaching C1a. Examining one's teaching practices C1b. Discussing, one's teaching practices C1c. Questioning one's teaching practices C2a. Develop a positive attitude towards learners driving the learning process

	C2b. Accept that the results of the lesson might not be the ones initially planned C3a. Disposition to team-working, collaboration and networking C3b. Sense of self-efficacy
Scenario Title	***Teaching and learning strategies using project-based learning***
Rationale	This course will allow teachers to know the methodology of teaching based on research projects. Its relationship with the curriculum, its phases, and resources for its design and evaluation will be made known. Learning based on research projects in the science classroom (natural sciences, biology, geology, physics and chemistry) allows students to design, carry out and communicate the results of their own research. In addition, throughout the process, students collaborate with scientists or non-formal education institutions such as science museums, or scientific disseminators. It is considered that this methodology contributes to acquire scientific competence as we consider it today. On the one hand, it is useful to acquire knowledge, skills and attitudes towards science, as well as apply them to the resolution of concrete and contextualized problems. In addition, it helps to acquire the necessary skills to become active citizens and participants in science and its development. At a European level, this is known and promoted under the concept of Responsible Research and Innovation (IIR).
Training objectives	STEM teachers are expected to develop knowledge, skills and attitudes about teaching with research projects in the science classroom. More specifically, they will develop: A. Knowledge: A1. Develop the understanding of the pedagogical strategy of the inquiry projects A2. Develop the awareness, knowledge and understanding of the teachers on the phases of a lesson based on the inquiry projects B. Skills: B1. Analyze teaching units based on inquiry projects B2. Design and implement a data collection strategy to find out about an aspect of education through inquiry projects B3. Develop collaboration skills with agents involved in the teaching of science, such as researchers, science communicators, science museums, NGOs … C. Dispositions & attitudes: C1. Perceiving science as an activity that is carried out through the interaction of many social agents, not just scientists / chemists C2. Be comfortable with the idea of the teacher as a facilitator of knowledge C3. Understand that students are responsible for their learning
Learning outcomes	A. Knowledge: A1a. Definition and objectives of the scientific inquiry projects A2a. Characteristics and examples of scientific inquiry projects A2b. Educational resources for the design of scientific inquiry projects B. Skills: B1a. Develop skills to select a subject for the inquiry project that is relevant to the students and appropriate to achieve the objectives of the curriculum. B1b. Develop skills to select educational resources appropriate to the subject and students B2a. Prepare a research question, a data collection strategy and carry it out B2b. Analyze the collected data and draw conclusions. B3a. Determine the tasks that a scientist or other collaborator can do to the project B3b. Behave as an interlocutor between the school and the research center C. Dispositions and attitudes: C1a. Have an open attitude towards citizens collaboration in scientific endeavour C1b. Be open to the idea of participation of organisations such as companies, NGOs or governments in creating scientific knowledge

	C2a. Conceive the teacher as a facilitator between students and knowledge/skills/attitudes C2b. Accept that the teacher might not know the results of the lesson or how the class will evolve C3a. Think of students as active seekers of knowledge, not receivers C3b. Develop a positive attitude towards students talking in class
Scenario Title	**Strategies for introducing Socio-Scientific Issues in the classroom: dilemmas and conversations**
Rationale	This module is useful for STEM teachers who have some awareness and knowledge about teaching with socio-scientific issues, and want to learn more about its applicability in the classroom. In this module, teachers will increase their awareness and knowledge about pedagogical strategies to teach with socio-scientific issues, namely dilemmas and conversations. They will also develop their skills on planning, implementing and reflecting on its application in the classroom. Finally, they will develop attitudes about their role and the role of students in this type of learning scenarios.
Training objectives	STEM teachers are expected to develop knowledge, skills and attitudes about two pedagogical strategies supporting the teaching of of socio-scientific issues in the classroom, namely dilemma and conversation. More specifically, they will develop: A. Knowledge: A1. Develop teachers' knowledge about curricular goals related to active citizenship A2. Develop teachers' awareness, knowledge & understanding about the pedagogical strategy known as a inquiry-based learning scenario with a dilemma to teach with Socio-Scientific issues B. Skills: B1. Select a socio-scientific issue to apply in the classroom B2. Design and implement a data collection strategy to learn about how to implement socio-scientific issues in the classroom C. Dispositions & attitudes: C1. Understand the Nature of Science as a process in which several social actors are involved, not only scientists C2. Be comfortable with the idea of the teacher as a facilitator C3. Think of students as drivers of their own learning process
Learning outcomes	A. Knowledge: A1a. Goals and definition of Socio-Scientific issues A1b. Characteristics of a dilemma, examples of socio-scientific dilemmas A2a. Goals and definition of scientific conversation A2b. Techniques for effective scientific conversation: organize tasks, create groups, prepare the conversation, support the conversation, decide. B. Skills: B1a. Develop ability to select / design a dilemma which is relevant and engaging for teaching a particular socio-scientific issue to a specific group of students B1b. Enhance ability to select / create supporting materials for students to solve the dilemma B1c. Develop techniques to guide, assist and scaffold students in solving the dilemma B2a. Develop ability to choose / design the conversation scheme most suited for teaching a particular socio-scientific issue to a particular group of students B2b. Develop skills to help all students engage in the conversation B3a. Develop student observation skills so to collect data to improve teaching practice B3b. Enhance reflection skills and come up with ideas to improve practice C. Dispositions and attitudes: C1a. Develop an attitude that science is not only performed by scientists but that all citizens should participate in scientific discussion

	C1b. Consider the role that ethics and moral judgements play in science C2a. Conceive the teacher as a facilitator between students and knowledge/skills/attitudes C2b. Accept that the teacher might not know the results of the dilemma or how the class will evolve C3a. Think of students as active seekers of knowledge, not receivers C3b. Develop a positive attitude towards students talking in class
STEM related issues	
Scenario Title	**Overcoming key difficulties of Inquiry Based Learning for STEM teachers**
Rationale	This course aims at teaching staff with certain experience in IBL. Teachers, despite being convinced of the benefits of the IBL methodology, often refers to the difficulties involved in applying it to their classes. Sharing these concerns and finding solutions or strategies for addressing them, is a basic need that is revealed in all the CPD training courses, conferences or workshops on this topic. This course is intended to empower teachers to make them more independent in the design, planning, implementation and management of their IBL-based STEM teaching. The teaching staff, organized into a learning community, will share and investigate the difficulties found in any of the phases involving the implementation (and the design and planning) of a IBL-based teaching sequence. The aim of his investigation will be, on the one hand, to demonstrate the difficulties more frequent and, for the other, find and share strategies that help addressing them successfully. In this process, teachers will develop the "learning to learn" competence, it is expected that teaching professionals will increase their confidence in tackling the main issues IBL poses in practice.
Training objectives	The course aims at STEM teachers holding a certain experience in using IBL methodologies. It is hoped that the course will contribute to the improvement of teachers' professional skills in managing their teaching using IBL methodologies. As specific objectives, participants will be able to: • Deal with (and prevent them) the difficulties (problems and concerns) that often arise with the use of IBL methodology in daily educational practice. • Classify the nature of these difficulties, according to the field where they come, in order to optimize the search for solutions. • Investigate and share strategies to overcome these difficulties. • Learn how to find and obtain resources and strategies to address positively these difficulties. • Work cooperatively with other participants, learning from each other, consolidating, at the end of the course, a community of practice for educational professional support. • Gain confidence in the design and use of IBL.
Learning outcomes	At the end of the training the participating teachers will be able to: • Build a "bank of resources" that can be used to deal with key difficulties that may appear during the design and/or implementation of didactic sequences based on IBL methodology. • Form part of a professional learning community, created along the course, for supporting each other. • Access to professional resources (individual) for CPD, while gaining confidence in using IBL for STEM teaching
Scenario Title	**Dealing with diversity in education: gender differences, learning styles, personalisation, etc.**
Rationale	In this module, the STEM teachers will improve their awareness and knowledge of pedagogical strategies such as dilemmas and discussion groups, develop their skills to plan, implement and reflect on classroom activities using them, and develop attitudes about their role as teachers, and the role of students.
Training objectives	• Knowledge on teaching approaches for inclusion,diversity and personalisation in STEM • Awareness on gender issues: strategies for dealing with gender differences in the STEM classroom. • Interpersonal skills and ability to adapt to educational learning pace.

	• Positive attitudes towards their own teaching practices, and positive dispositions on promoting different learning styles.
Learning outcomes	Teachers will be able to: • Teaching STEM considering inclusiveness and personalisation • to model effective STEM instruction based on engaging approaches which meet the needs of every learner • demonstrating strategies and attitudes against gender discrimination in the classroom • promoting STEM related roles that are equal in terms of gender. • Adapting assessment tools to the classroom differences
Scenario Title	**Emerging ICT technologies in STEM education: computational thinking, robotics, and game-based learning**
Rationale	In this module we will explore new tools and approaches to attract students to STEM while working curriculum contents. Areas as computational thinking represent a good approach to problem solving processes guided by inquiry, which can be used not only in STEM but in humanities, which open the opportunities to interdisciplinary project work. Robotics is a new approach linked to the previous one in terms of working and play with programming for all. Game-based learning is also a good strategy to integrate STEM concepts using game approaches.
Training objectives	• knowledge on teaching approaches on computational thinking via interdisciplinary inquiry-based projects. • knowledge on solving problems via robotics using inquiry methodologies • Knowledge on attracting students to STEM using game approaches.
Learning outcomes	Teachers will be able to: • Awareness on using innovative and engaging pedagogical tools and approaches to attract students to STEM, such as GBL and IBL. • Design STEM interdisciplinary learning scenarios integrating digital technologies, such as robotics, game-based learning, etc.

Common teachers / parent scenarios

Scenario Title	**Supporting gender-neutral approaches to STEM at home**
Rationale	Secondary teachers' training should include elements that help parents in avoiding gender bias with their younger children as well as trying to balance previously established bias for the ones in secondary school. For this there is a need to raise awareness of teachers and parents of bias and to offer methodology to find solutions for balancing in their daily practice in a way that is based on true parental engagement.
Training objectives	**Enhanced knowledge and understanding on contextual aspects of learning and teaching** • understanding the (un)supportive home environment • understanding the general attitude towards STEM subjects • identifying entry points to influence attitudes and discourse **Enhanced professional skills- relating to teachers' role as part of educational communities** • enhance communication skills with special focus on non-professional adult audiences • holistic, not subject-segregated approach to STEM • engaging parents in STEM teaching
Learning outcomes	***Demonstration of knowledge on educational sciences foundations*** *(sociological knowledge)* • *gain a deeper understanding of the roots, causes and effects of early and ongoing gender bias in STEM* • *strengthen the holistic approach to STEM, having a higher level of teachers' awareness of subjects they do not teach*

	• *strengthen the holistic approach to education by gaining a deeper understanding of early childhood education and home education on school-related learning outcomes and attitudes* ***Demonstration of collaboration skills*** (with colleagues, parents and social services) • *deeper understanding of different forms of parental engagement and having toolsets for different groups of parents* • *practical tools to provide opportunities for parental engagement in the school and outside* • *practical tools for collaborating with colleagues within the school for offering holistic, STEM related programmes* ***Demonstration of ability to adapt to educational contexts*** • *development of home-school collaboration tools, based on the local context, in order to increase the level of understanding on the importance of STEM by parents and help them avoid gender bias or balance an existing one*
Scenario Title	**Overcoming personal bad experiences of parents for STEM success of their children**
Rationale	Traditionally STEM subjects are considered difficult and in public discourse it is considered natural that a student struggles with STEM subject, while arts subjects are considered differently. This is based on anecdotal, experiential parental approaches, mostly based on their own schooling experiences. The use of innovative teaching methodology and technology can help counterbalance this on two preliminary conditions: teachers' awareness of this phenomenon and tools to change parental mindsets and attitudes
Training objectives	**Enhanced knowledge and understanding on contextual aspects of learning and teaching** • understanding the (un)supportive home environment • understanding the general attitude towards STEM subjects • identifying entry points to influence attitudes and discourse **Enhanced professional skills- relating to teachers' role as part of educational communities** • enhance communication skills with special focus on non-professional adult audiences • holistic, not subject-segregated approach to STEM • engaging parents in STEM teaching
Learning outcomes	***Demonstration of knowledge on educational sciences foundations*** *(sociological knowledge)* • *gain a deeper understanding of STEM's position in different societal groups' understanding* • *strengthen the holistic approach to STEM, having a higher level of teachers' awareness of subjects they do not teach* ***Demonstration of collaboration skills*** (with colleagues, parents and social services) • *deeper understanding of different forms of parental engagement and having toolsets for different groups of parents* • *practical tools to provide opportunities for parental engagement in the school and outside* • *practical tools for collaborating with colleagues within the school for offering holistic, STEM related programmes* ***Demonstration of ability to adapt to educational contexts*** • *development of home-school collaboration tools, based on the local context, in order to increase the level of understanding on the importance of STEM by parents and change their attitudes towards these subjects*

Digital platform for structuring the scenarios

As a basic IBL online platform it is chosen the DojoIBL cloud system (http://dojo-ibl.appspot.com), developed under the weSPOT project and covering all levels and phases of the weSPOT and other inquiry-based models. The system helps teachers and students to carry out collaborative learning processes like e.g. inquiry-based learning or problem-based learning. It provides a very simple, but powerful interface. Teachers/facilitators can create (or reuse) inquiry structures, and arrange multiple groups of students working on them. The students/learners can collaborate, and make use of the different functionalities to keep track the group progress and the overview of the project. The user interface is translated in the languages of the four ELITe countries. In addition, each country can integrate the DojoIBL content in other e-learning systems, specific for the institution, implementing the teachers' competence development scenario, and with variety of ICT tools, appropriate for specific activity and / or skill development.

Examples of digital scenarios

Following the continual improvement process the consortium has decided, after the identification of the thematic areas for all 8 scenarios per country, to separate the implementation process to two stages. At first stage to be fully described, implemented in the IBL platform, and piloted, four scenarios per each country. At the end of the stage the scenarios conducting should be evaluated and the result to be integrated in the development, implementation and conducting of the next four scenarios. This will ensure the improvement of the teachers' competence development framework. For each country there is a representative example of the digital interactive scenarios, structured in DojoIBL system.

An example of a Greek scenario

Scenario title:	**Design and delivery of an interdisciplinary STEM project**
Purpose:	To facilitate STEM teachers co-develop an interdisciplinary project (planning, managing and accessing students' outcomes of a developed project) by reviewing, reflecting and adjusting resources developed in the frame of the ENGAGE project.
Mode of implementation:	Blended/online
DojoIBL scenario URL:	https://dojo-ibl.appspot.com/#/project/5096557594542080
Access Code:	E12OV

Duration: Approx. 25 learning hours (3 weeks)

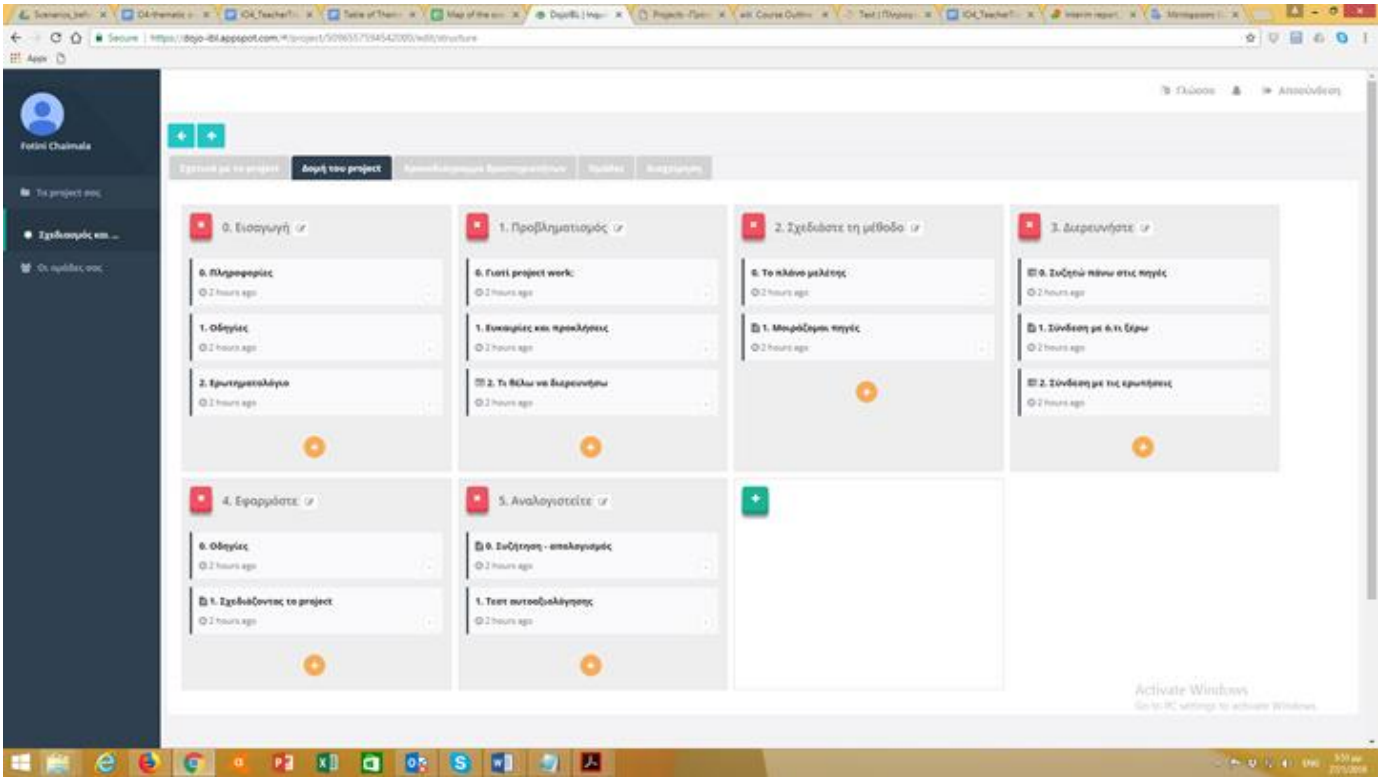

Fig. 1 Module structure

Training outline/methodology:

Phase 1: Questioning (*1.1.* Motivation – why interdisciplinary project work; *1.2.* Reflection – Opportunities and challenges for project work)

Phase 2: Planning the method (2.1. Reflection –research questions; 2.2. Methodology – Teachers will be divided in groups (interdisciplinary) and be asked to choose a topic and prepare a project (how I will find out; decide on the method (s) – review of resources, action research, individual or collaborative learning in a team… ; make a plan for research, tasks and deadlines)

Phase 3: Data collection 3.1. Gather/review information - Resources from the ENGAGE project; 3.2 Systematic data collection and sharing – record keeping of data and findings and sharing with co-learners; 3.3. Reflection- Reflecting on what knowledge was gained so far, and examining and evaluating this aspect of the learning experience

Phase 4: Data analysis 4.1. Analysis of the data obtained and summary of the analysis results; 4.2. Reflection - Checking the analyses and coming up with alternatives, and examining and evaluating this aspect of the learning experience

Phase 5: Data interpretation 5.1. Fit of results with existing knowledge; 5.2. Counterevidence - Judging evidence and counter evidence in discussion forums; 5.3. Reflection - Relevance of results to the question, checking the interpretation (process) and coming up with alternatives, and examining and evaluating this aspect of the learning experience

Phase 6: Communication 6.1. Presentation of project to co-learners and what they have learned from the learning process (with the aid of a KWHL grid – i.e. background knowledge; what I wanted to know; how did I found out; what I have learnt); 6.2. Reflection: Implications, limitations, lessons learned - Discussing the findings in a critical manner (e.g. implications, limitations of approach, lessons for future studies) ; Providing feedback on findings of others; Self-evaluation

Completion requirements: Learners should

- participate in the discussion forums & complete the tasks in each phase;
- prepare and present the design of an interdisciplinary project;
- provide feedback on co-learners' developed projects.

An example of a Dutch scenario

Scenario title:	**Learning to design Inquiry-based Learning with DojoIBL**
Purpose	To help teachers design and orchestrate IBL with the support on DojoIBL online platform
Mode of implementation:	Online
DojoIBL scenario URL:	https://dojo-ibl.appspot.com/#/inquiry/5175288992366592
Access Code:	L1DQU

Duration: Between 15 and 30 learning hours (one or two week options will be provided)

Training outline/methodology:

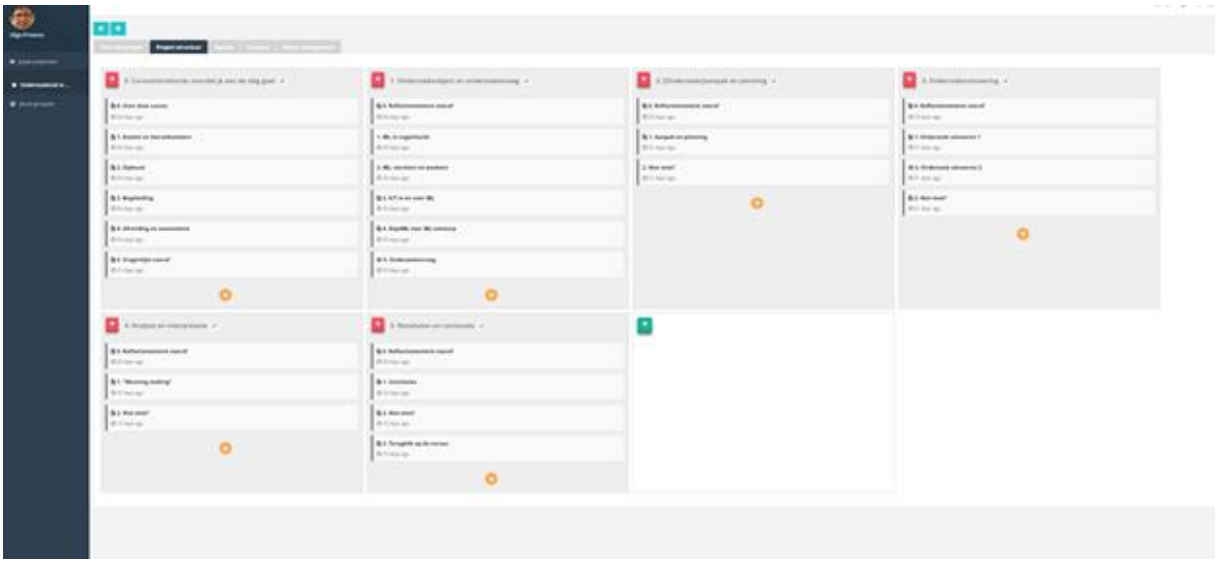

Fig. 2. Teacher/Designer perspective (all phases and activities)

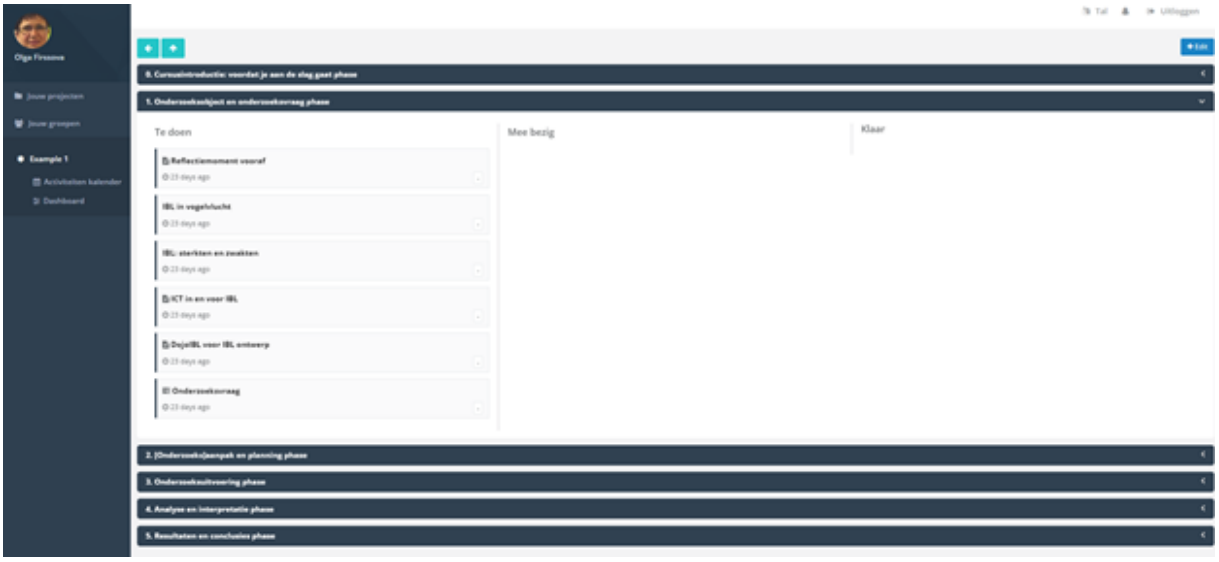

Fig. 3 Student perspective: phase one prior to activity

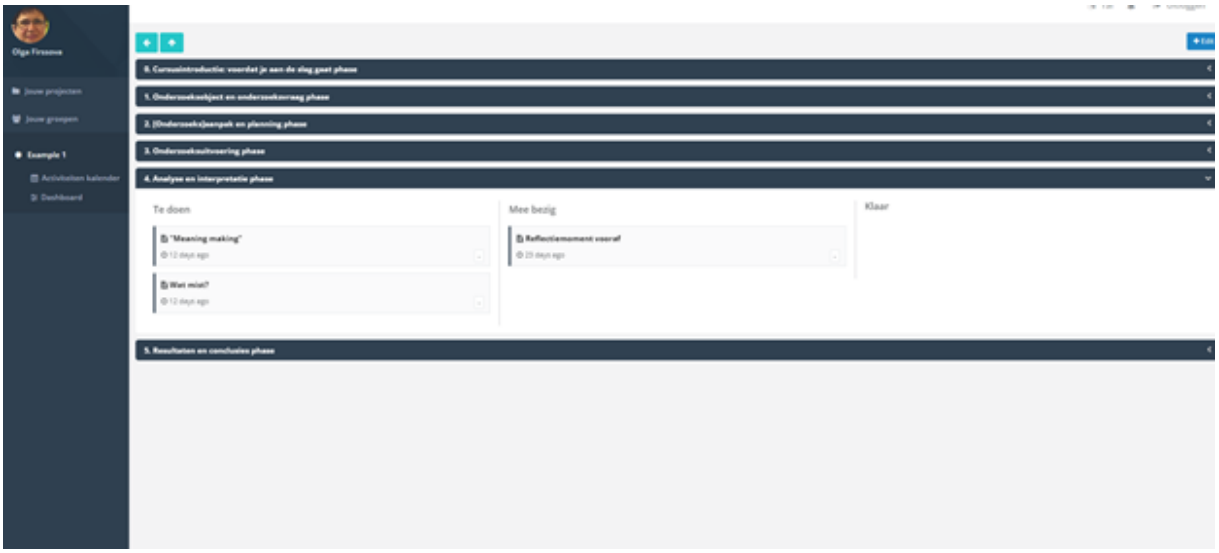

Fig. 4 Student perspective: one activity is in progress

The module will be delivered in compliance with ibl methodology to follow teach as you preach principle.

Confirmation inquiry level will be used to construct a worked example scenario of the course which learners may choose to get acquainted with the tool and the way the tools supports IBL practice.

Participants though will be able to follow the course in the guided mode, turning to the worked example for guidance and benchmarking. Participants will be encouraged to investigate the possibilities DoJo IVL offers and reflect on them against the basic concepts of IBL which will be presented in a compact way through worked examples (built-in elaborations and presentations).

The course will follow the inquiry phases

Phase 1: Questioning (Challenges of IBL)

1. Trigger: what makes IBL challenging for classrooms? Activating knowledge, exchange of ideas and examples.
2. Introduction of the way Dojo tackles challenges (teacher and learner perspective) against an overview of central concepts of IBL learning. One challenge will be presented as a worked example
3. Reflection on the provided example and other challenges. Discussion and defining challenges for further exploration (inquiry)
4. Group formation around challenges for further investigation and defining research questions

Phase 2: Planning the method

5. Reflection (what do I want to know): participants (individually or as a group)reflect on what needs to be done to get answers.
6. Methodology: participants (individually or as a group) decide on how to proceed, make plans and divide tasks

Phase 3: Data collection

3.1. Collecting/Reviewing information: dependent on the challenge selected for inquiry participants read provided material (articles and/or video presentations) and/or search for additional material and explore dojoIBL IBL functionalities.

3.2. Sharing experiences: findings shared with other participants

3.3. Reflection: reflection on the process, on own findings and findings of others

Phase 4/5: Data analysis & interpretation

4.1. Analysis: systematic sorting of the findings and experiences, attempt to distinguish communalities and specific issues

4.2. Reflection of possible implications for one's own practice

Phase 6. Communication

6.1. Discussion of the outcomes of the course with co-participants and instructors

6.2. Reflection: Implications, lessons learned and personal to-do plans of possible further use of dojoIBL; feedback to the DojoIBL designer (what is missing, what can be changed and why)

An example of a Bulgarian scenario

Scenario title:	**The challenges in the new ICT curriculum for 8-th grade**
Purpose:	To help teachers to feel more confident in implementation of the new ICT curricula for 8-th grade.
Mode of implementation:	Face-to-face
DojoIBL scenario URL:	http://dojo-ibl.appspot.com/#/inquiry/5145710492123136
Access Code:	HNUGF

Duration: 16 academic hours

Training outline/methodology:

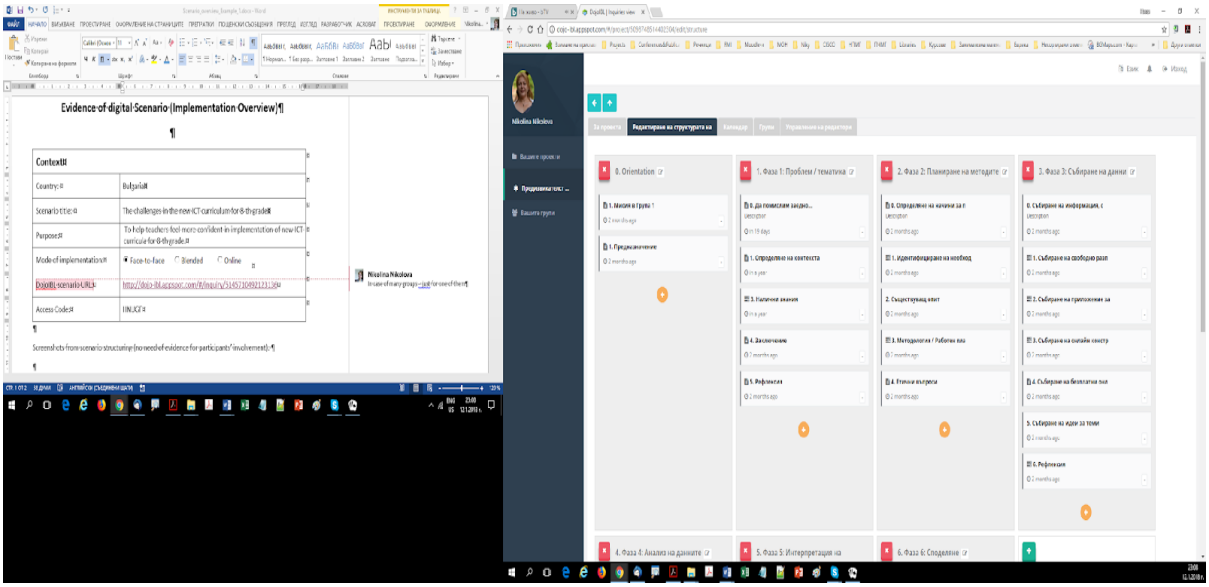

Fig. 5 Course Structure

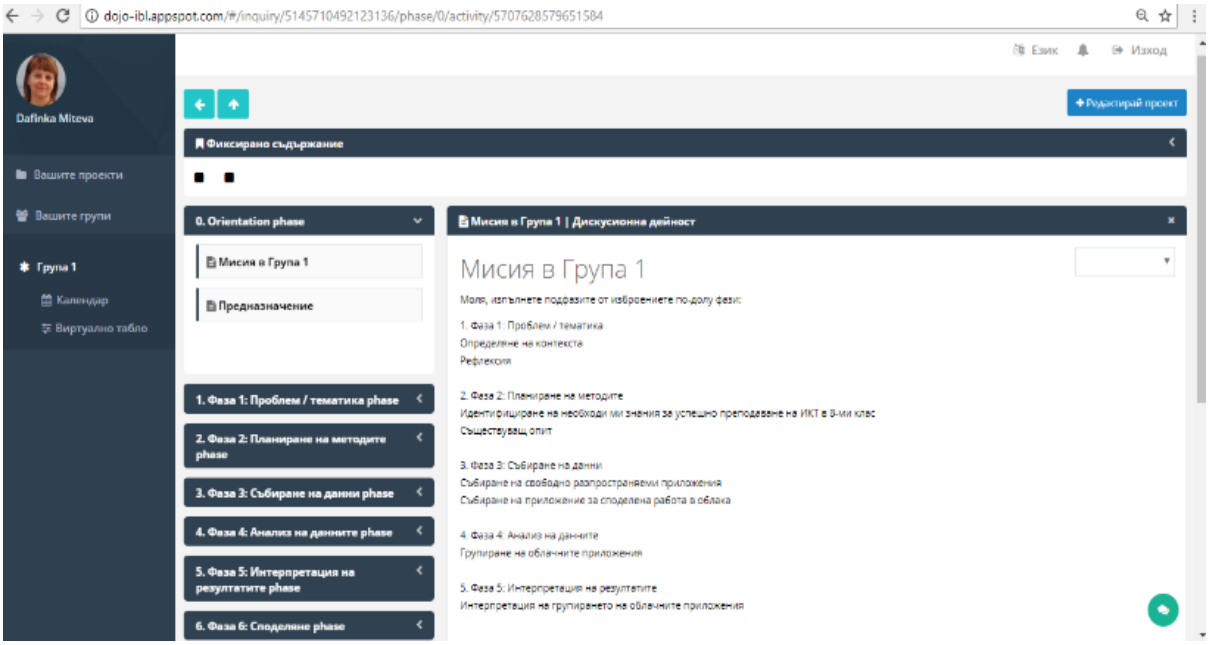

Fig. 6 Interactive activities

Phase 1: Problem / Topic Participants identifies the similarities and differences between previous one and the new curricula. They share experience on new topics and outline the main challenges in implementing the new curricula

Phase 2: Operationalization: 2.1. Identifying ways for supporting secure and safe environment in the computer lab; 2.2. Identifying the content knowledge needed for successful teaching ICTs in 8-th grade. Participants develop together an work plan for 'filling the gaps' taking into account current experience and ethical issues.

Phase 3: Data collection: Collection of the content knowledge, free desktop applications for hand-on sessions with student on installation and uninstallation in the computer labs, cloud application for shared work, online web site constructors, free online application / tools for project management. During the reflection the groups discuss in teams how to select appropriate resources and tools for their classroom.

Phase 4: Data analysis: Participants rank the list of applications, cluster the cloud application, provide comparative analysis of project management applications. Before selection they discuss the rights of use, limitations, adds, security issues.

Phase 5: Interpretation of the results: The participants maps the lists of tools and learning resources and remove these ones which does not meet the ethical issues. By voting and argumentation they choose appropriate learning materials and tools for their classrooms. They formulate and discuss ideas for students' projects.

Phase 6: Communication Lesson plan preparation and presentation. Discussing implications and limitations. Peer evaluation. Reflection and feedback about the course quality.

An example of a Spanish scenario

Scenario title:	**Strategies for introducing socio-scientific issues in the classroom: dilemmas, controversies, conversations**
Purpose:	STEM teachers are expected to develop knowledge, skills and attitudes about two pedagogical strategies supporting the teaching of of socio-scientific issues in the classroom, namely dilemma and conversation.
Mode of implementation:	Online
DojoIBL scenario URL:	http://dojo-ibl.appspot.com/#/inquiry/5723192383504384
Access Code:	EH99J

Duration: Approx. 30 learning hours

Training outline/methodology:

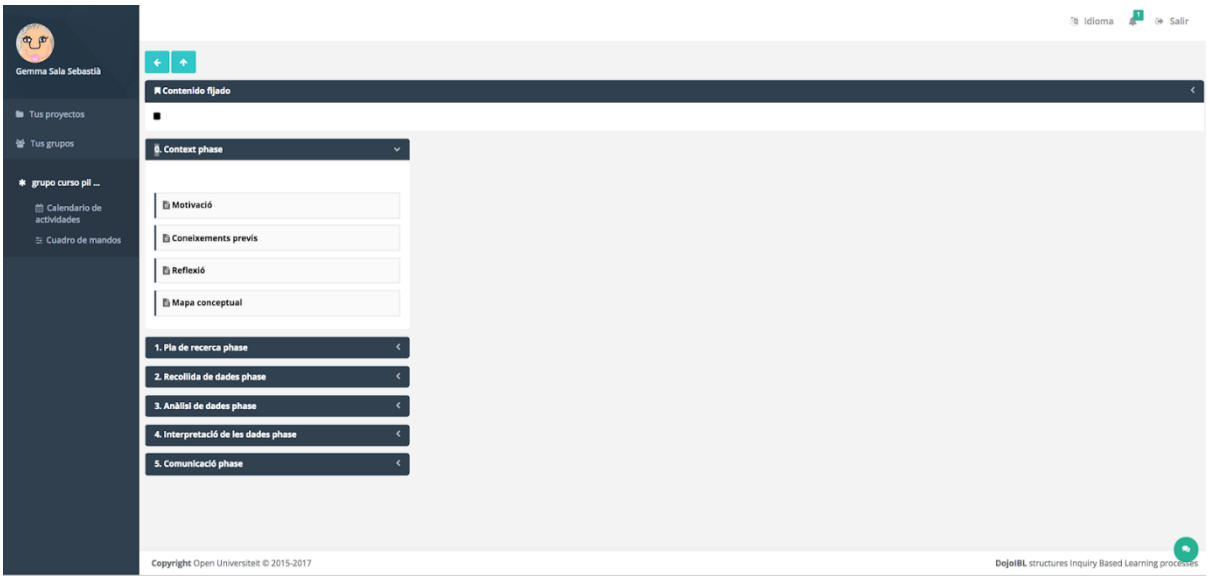

Fig. 7 Course Structure

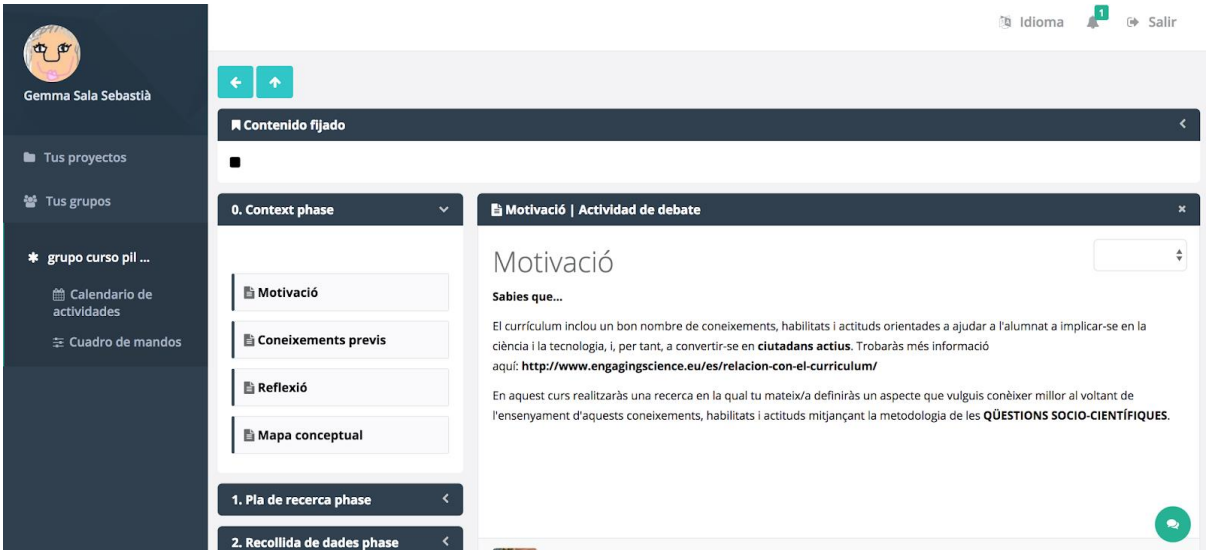

Fig. 8 Course interactive implementation

Phase 1: Questioning

1. Motivation – why to use dilemma and conversation to teach SSI
2. Existing knowledge – existing knowledge about scientific issues that could become a dilemma, existing knowledge about how scientific conversation can help achieve certain goals in the curriculum, knowledge about students' motivation towards science, other pedagogical strategies that are similar to dilemma and conversation, teachers provide examples of effective dilemmas and conversations in the classroom.
3. Reflection – reflecting on own teaching practice, what are the challenges to apply these pedagogical strategies from a personal, school, curricula, educational system perspectives.
4. Concept mapping of opportunities and challenges → definition of research question (s)

Phase 2: Planning the method

2.1. Prediction – what do I predict that the answer to my question would be

2.2. Reflection – what is my research question, what do I need to know to investigate my research question

2.3. Methodology – how I will find out; decide on the method (s) – review of resources, action research, individual or collaborative learning in a team… ; make a plan for research, tasks and deadlines

Phase 3: Data collection

3.1. Data collection - In respect to the research question to be answered and on the basis the outcomes of reflection on "what do I need to know" teachers review relevant information from resources uploaded in the platform (indicative: readings, videos, and presentations on dilemma and conversation; teaching learning materials using dilemmas and conversation) or conduct action research

3.2 Systematic data collection and sharing – record keeping of data and findings and sharing with co-learners

Phase 4: Data analysis

4.1. Analysis of the data obtained and summary of the results

Phase 5: Data interpretation

5.1. Compare: Fit of results with existing knowledge

5.2. Evidence & Counterevidence - Judging evidence and counterevidence in discussion forums

5.3. Reflection - Relevance of results to the question, checking the interpretation (process) and coming up with alternatives, and examining and evaluating this aspect of the learning experience

Phase 6: Communication

6.1. Presentation of the learning experience to co-learners (with the aid of a KWHL grid – i.e. background knowledge; what I wanted to know; how did I found out; what I have learnt)

6.2. Reflection: Implications, limitations, lessons learned - Discussing the findings in a critical manner (e.g. implications, limitations of approach, and lessons for future studies); providing feedback on findings of others

Access to the digital scenarios

All digital scenarios and informative documents in the national languages for Greece (GR), the Netherlands (NL), Bulgaria (BG) and Spain (ES) can be accessed here below:

Scenarios GR: http://www.learning-in-teaching.eu/index.php/en/intellectual-outputs/io4/scenarios-gr

Scenarios NL: http://www.learning-in-teaching.eu/index.php/en/intellectual-outputs/io4/scenarios-nl

Scenarios BG: http://www.learning-in-teaching.eu/index.php/en/intellectual-outputs/io4/scenarios-bg

Scenarios ES: http://www.learning-in-teaching.eu/index.php/en/intellectual-outputs/io4/scenarios-es

Conclusions

European large issues, related to the STEM teachers competence

The methodology of development *Learning In Teaching Via E-Inquiries* framework and developed scenarios in this framework arise the common topics in four participating countries which is base for assumption that the topics belong to the European large set of STEM teachers' professional development issues, which needs non-traditional way of solving. Among the common topics of interests they are:

- Innovative STEM methodologies (IBL & project work, self-directed learning, computational thinking) (5 scenarios)
- Opening up the STEM classroom (4 scenarios)
- Assessment challenges in STEM (3 scenarios)
- ICT enhanced STEM learning and teaching (3 scenarios)
- Inclusion and diversity (3 scenarios)
- Teaching STEM for skills development (3 scenarios)
- RRI in STEM education (2 scenarios)

The fact that the topic are explored by different countries with different educational systems, level of students' presentation, and policy context leads to the conclusion that ELITe teachers' competence development framework as well as provided scenarios will have European large impact on the teachers' professional development.

IO4 impact on further work

The scenarios, developed under the ELITe Output 4 will be implemented by each partner and validated during the next phase. Based on the evaluation results and participants feedback, the next phase, with improved scenarios will be implemented. The scenarios by themselves are published online by the ELITe website and DojoIBL platform, so they can be re-explored by different organizations, providing teachers' professional development.

The input from implementation will be used for extracting guidelines and good practices for the teachers' handbook.

The results of scenarios implementation and evaluation will form the base for development of final framework for STEM teachers' competence development approach

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