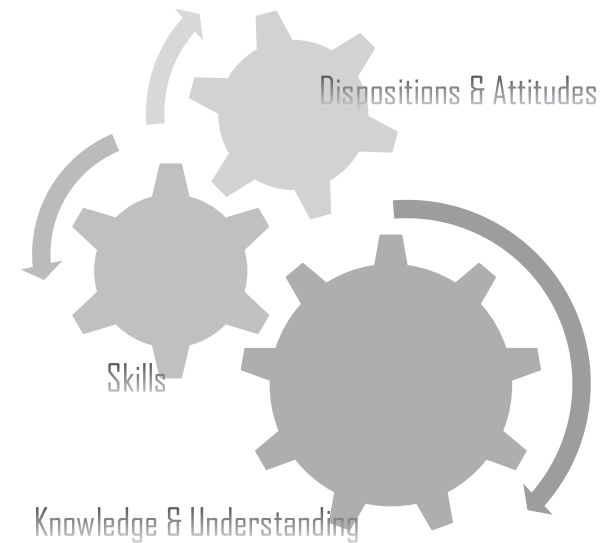


SUPPORTING STEM TEACHERS INQUIRY AND REFLECTIVE PRACTICE

The ELiTe project's recommendations towards a
new model for STEM professional learning

Briefing Document

Inquiry & Reflective practice



elite



learning-in-teaching.eu

ELITE is concerned with supporting Science, Technology, Engineering and Mathematics (STEM) teachers' development of knowledge, skills and attitudes so that they can effectively address their roles as lifelong learners, facilitators of students' learning and members of educational communities. It aims, on the one hand, to highlight the links between inquiry skills practicing and STEM teachers' competence development, and, on the other, to inform curriculum development in STEM teachers' education.

Project: Enhancing Learning in Teaching via e-inquiries (ELITE)

Program: Erasmus +, Strategic Partnerships for school education, 2016-2019

Extended document available in:

<http://learning-in-teaching.eu/index.php/en/intellectual-outputs/io10>



Erasmus+



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The need for reconsidering STEM professional learning provisions

The provision of effective Continuous Professional Development (CPD) for STEM teachers is prioritized by policy and policy mediation across EU countries. The underlying concern is to support teachers facilitate students to acquire the competences they need for living and working in the 21st century [1].

Research literature and recent TALIS surveys results [2] provide insights on characteristics of impactful forms of CPD, among others being: school based activities, participation in professional networks, active learning and cooperation based on innovation, content adapted to practice needs, sustained length and follow-up activities.

However, TALIS 2018 survey reports low participation rates of teachers in the kinds of professional development that have shown to be effective. Survey results also indicate a mismatch between STEM teachers' needs for training and the actual content and learning modes of activities that are provided – results that call for a need to re-conceptualize and reconsider STEM professional learning provisions.

[1] See for example

<https://www.schooleducationgateway.eu/downloads/Governance/2018-wgs6-Full-Final-Output.pdf>

[2] TALIS 2018 report https://read.oecd-ilibrary.org/education/talis-2018-results-volume-i_1d0bc92a-en#page154

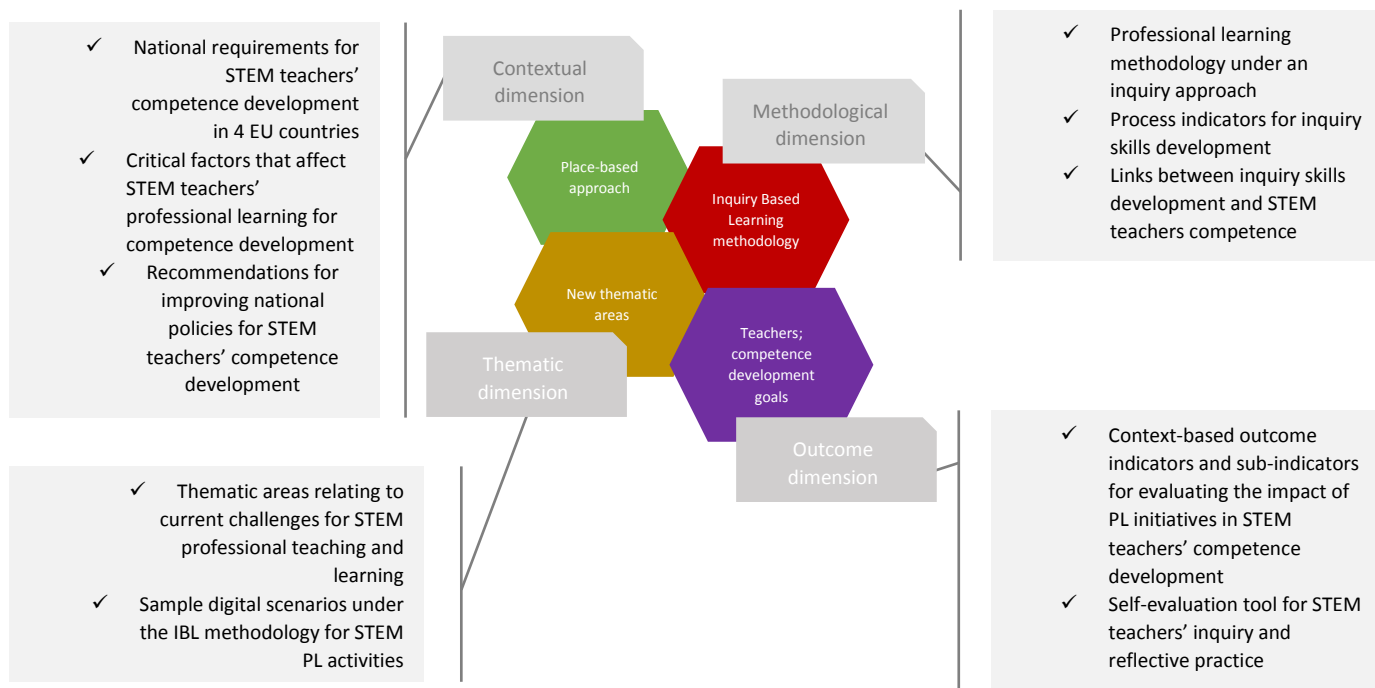
[1] The ELITE framework is, reported in the ELITE project Intellectual Output O10.
Access O10 in <http://learning-in-teaching.eu/index.php/en/intellectual-outputs/io10>

The ELITE project approach for 21st century STEM teachers' professional development

The ELITE approach for STEM professional development calls for **a reconsideration of professional learning provisions under the perspectives of:**

- 1. Adopting place-based approaches**, taking into consideration national policy requirements and practice needs;
- 2. Modernizing the thematic of STEM teachers learning provisions**, addressing content areas that reflect current policy orientations on the broader aims of STEM education and teachers' practice needs;
- 3. Targeting towards continuous development and assessment of STEM teachers' competences**, needed for their challenging roles as learners, teachers and members of educational communities;
- 4. Utilizing the potential of the Inquiry Based Learning (IBL) methodology**, as a means for inquiry and reflective skills practicing and teachers' competence development.

The ELITE project framework for STEM professional development under an inquiry and reflective approach: dimensions & components [1]



The ELITe approach advocates that **efforts to stimulate teachers' competence development through professional learning opportunities need to be place-based.**

Place-based approaches to CPD are premised on the involvement of educational stakeholders from policy, policy mediation and practice on the conceptualization, definition and implementation of professional learning provisions within educational contexts. Taking into consideration the various interpretations and understandings not only among the different EU educational systems but also among different stakeholders in each country is considered important for facilitating policy ownership and policy implementation from teacher training organizations and practitioners.

Challenges for STEM professional learning for competence development: the case of 4 EU countries [1]

- ✓ **In the national contexts of Greece, Bulgaria and Spain the main challenge identified in respect of STEM teachers' competence development lays on the grounds of policy mediation**, i.e. on how the teacher educational institutions and providers implement policy envisions and requirements.
- ✓ **In the Dutch context**, on the other hand, given that the regulatory framework for teachers' competence development has long been established and implemented by mediating mechanisms, **the main issue identified for further exploration and discussion is on the impact of teacher learning for competence development on the school practice.**

Critical factors that affect STEM teachers' competence development relevant to the national contexts of Greece, the Netherlands, Bulgaria and Spain [2]

Greece

Lack of effective communication of policy priorities to policy mediators and practitioners

Fragmentation of training provisions & lack of coordination between policy mediation actors

'Top-down' approach for teachers' professional development rather than a 'partnership approach'

Continuous professional development for STEM teachers is in practice optional and there is a lack of culture for lifelong professional learning

Current teacher training provisions are not aligned with practitioners learning needs in respect to practice requirements – both from content & appropriate training methodologies

The Netherlands

There is a need for:

Facilities for professional learning

Informal learning support

Interaction and exchanges with colleagues

Peer feedback and consultation

Collaboration, joint work on learning environment

Access to knowledge & doing research

Organizational changes, making school an organization for professional learning

Self-directness and self-regulation

Being able to reflect one's actions, reflecting on one's skills, motivations and ambitions, learning to make mistakes and learn from them

Teacher skills, learn to motivate students, develop better digital skills, time management skills

[1] Outcomes of the documentary analysis of the national contexts (policy documents, STEM teacher training curricula, students' STEM curricula reported in the ELITe project Intellectual Output O1.

Access O1 in <http://learning-in-teaching.eu/index.php/en/intellectual-outputs/io1>

Bulgaria

There is a need for:

STEM subject matter – new science achievements as well as changes in the students' curricula

Interdisciplinary – practical trainings combining different STEM subject matter and relationships

Innovative, interactive teaching methods

Work with special students' groups, tailored to the specifics of the subject and the educational need

Work with parents

Dealing with administrative issues

Evaluation in education

Face-to-face or blended learning professional learning approaches

Spain

Teachers lack training on STEM-related methodologies, and examples of good practice.

Need of application of active teaching and learning methods in the classroom.

Inclusive education is still a challenge in front of Spanish teachers.

Work with parents and with other actors is essential

There a need for development of communities of practice between STEM teachers

Need for innovative training methodologies.

Need to adopt project work as the assessment methodology.

Considerations/Recommendations for policy

- ✎ Educational policy should consider place-based approaches to STEM Continuous Professional Development for addressing country-specific critical issues that impede upon effective policy implementation. ***The exchange of good practices among other EU educational contexts enhances the knowledge base and strengthens capacity building for effective policy implementation.***
- ✎ ***In the national contexts of Greece, Bulgaria and Spain*** – given that the main challenge identified in respect of STEM teachers' competence development lays on the grounds of policy mediation - ***educational policy should prioritize efforts for enhancing the communication of policy priorities, towards facilitating policy implementation and policy ownership from teacher trainers and practitioners.***
- ✎ ***In the Dutch context*** – given that the regulatory framework for teachers' competence development has long been established and implemented by mediating mechanisms – efforts should focus on ***promoting initiatives that provide evidence on the impact of teachers' learning for competence development on the school practice.***

[2] Outcomes of the ELITE project Multiplier Events E1-2-3-4, reported in the project 's Intellectual Output O3.

Access O3 in <http://learning-in-teaching.eu/index.php/en/intellectual-outputs/io3>

Access the briefing documents "Supporting STEM teachers' professional learning for competence development: Insights on the space for intervention" for GR, NL, BG, ES in <http://learning-in-teaching.eu/index.php/en/briefing-docs/policy>

Results from TALIS 2013 and 2018 surveys provide evidence that ***there is a discrepancy between teachers' needs and topics covered currently in CPD.***

According to TALIS 2018 [1] more than 80% of the teachers reported attending training focusing on building knowledge (both subject-based and pedagogical), while there is no particular need for this kind of training; instead teachers report high training needs on ICT, teaching methods for multicultural skills and teaching methods for students with special needs.

[1] TALIS 2018 report https://read.oecd-ilibrary.org/education/talis-2018-results-volume-i_1d0bc92a-en#page154

Reflections on modernizing the thematic of STEM Continuous Professional Development in 4 EU national contexts [3]

Emerged from the Greek Multiplier Event

- The modernization of the thematic of STEM professional learning provisions was considered as an imperative among the ELITE project participant in the Greek negotiation event. Participants made reference that currently professional learning provisions are too theoretical, hardly addressing their practice needs.
- The ELITE thematic areas were evaluated as of high relevance to STEM teachers' needs for CPD. Most popular topics were: Dealing with socio-scientific RRI issues; ICT enhanced STEM learning and teaching; Teaching STEM for skill development; confronting challenges of new curricula and enhancing teacher-parent partnerships.

Proposed thematic areas for STEM professional learning activities & relevancy to the national contexts of GR, NL, BG and ES [2]

Thematic areas proposed for STEM CPD	Relevancy to the national contexts			
	GR	NL	BG	ES
Dealing with inclusion and diversity	O		O	O
Teaching STEM for skills development	O	O		O
Incorporating RRI in STEM education	O			O
Innovative STEM methodologies	O	O	O	O
Opening up school science	O	O	O	O
Assessment challenges in STEM	O	O	O	
ICT enhanced STEM learning and teaching	O	O	O	O
Confronting challenges of new curricula			O	
Enhancing teachers-parents collaboration	O	O	O	O

Emerged from the Dutch Multiplier Event

- The thematic areas proposed by ELITE were all found relevant and all courses delivered under the developed scenarios enjoyed interest with resulting high enrolments
- The attitude, however, of the learners on the implemented scenarios was that of "knowledge consumers" and the scenarios were hardly followed in a systematic inquiry fashion

[2] Read more on the ELITE project proposed thematic areas and the developed teacher training scenarios that address the thematic areas in the project's Intellectual Output O4 <http://learning-in-teaching.eu/index.php/en/intellectual-outputs/io14>



Emerged from the Bulgarian Multiplier Event



- Strengths of the ELITE approach in relation to the thematic dimension include: Relevancy of the thematic areas to the school needs of STEM professional competence development; Direct applicability of the sample digital scenarios in others institutions teachers' training practice; The proposed scenarios are directly achievable both in the local training of STEM teachers in one school and in international ERASMUS+ projects
- Among the opportunities for the adoption of the ELITE approach mentioned have been: sharing good practices rather than purely theoretical approach to the development of teacher training designs; creation of a national database with a description of best practices open to teacher trainers and teachers; development of shared platforms between academic institutions to describe innovative methods and good practices in the training of the teacher trainers.

Emerged from the Spanish Multiplier Event



- The thematic areas were considered by participants as relevant to teachers' needs.
- However some teachers were skeptical on the appropriation of innovative methodologies that address the proposed themes for the development of teacher training, unless there is evidence that the proposed methodology succeeds in the classroom.

Considerations/Recommendations for policy

- ✦ There is currently ample evidence according to large scale international and European studies that there is discrepancy between STEM teachers' needs for professional development and the thematic professional learning provision currently address. **Educational policy should prioritize the need teacher education organizations modernize the thematic of STEM CPD, so to address current challenges and needs in STEM teaching practice.**
- ✦ In relation to content of CPD provisions, the following **thematic areas are of current interest and relevance for STEM teachers' practice and it is proposed to be promoted by educational policy and to be incorporated in training provisions**: Dealing with inclusion and diversity; Teaching STEM for skill development; Incorporating RRI in STEM education; Innovative STEM methodologies; Opening up school science; Assessment challenges in STEM; ICT enhanced STEM learning and teaching; Confronting challenges of new curricula; Enhancing teachers-parents collaboration.
- **The modernization of the thematic of STEM CPD requires knowledge, skills and competences negotiations among policy and policy mediation, stakeholders and capacity building of the educators of STEM teachers.** Educational policy should initiate negotiation processes with teacher training providers and education stakeholders on the issue and support educators of teachers to develop and implement professional learning activities under the new thematic.

“Describing, defining and assessing teachers’ professional knowledge and competence at any career stage is not simple or straightforward, neutral or universal, fixed or certain, but historically and culturally bound, subject to change. Competence statements, so as to recognise the complex, multifaceted nature of teaching, acknowledging the role of values, ought to be clear and not over-elaborate. [...] Teacher competences should be high-level, broadly defined statements of the characteristics of teachers at different career stages, and therefore be built on a concept of teaching as praxis interweaving theory, practice and the ability to reflect critically on one’s own and others’ practice.” [1, p.12]

[1] Caenna, F. (2011) Literature review Teachers' core competences: requirements and development, EC, Education and Training 2020 Thematic Working Group 'Professional Development of Teachers'


[2] Access the briefing document: “Outcome indicators for evaluating the impact of initiatives on STEM teachers competence development” in

<http://learning-in-teaching.eu/index.php/en/briefing-docs/research>

[3] Access the ELITE self-evaluation tool for STEM teachers' competence development in

<http://learning-in-teaching.eu/index.php/en/intellectual-outputs/io6>

The ELITe project indicators and sub-indicators for evaluating STEM teachers' competences [2]

Outcome	Outcome Indicators	Sub-indicators	National contexts	
Through the participation in initiatives for STEM teachers' competence development, STEM teachers are expected to :	STEM teachers participating in initiatives for their competence development should demonstrate:	STEM teachers participating in initiatives for their competence development can document the following types of evidence:	in which the sub-indicators are relevant to:	
Develop knowledge & understanding on learning & teaching	Enha understa teachin	Through the participation in initiatives for STEM teachers' competence development, STEM teachers are expected to :	Through the participation in initiatives for their competence development, STEM teachers are expected to :	
	Enha understan methods re	Enhanced promoti	Through the participation in initiatives for STEM teachers' competence development, STEM teachers are expected to :	
	Enha understan methods re	Enhanc	Come to value learning and teaching: dispositions & attitudes	STEM teachers participating in initiatives for their competence development should demonstrate:
		Enhanced teachers	"I can do this"	Positive dispositions and attitudes relating to teachers own learning
	Enha understandi lea		"This is important to me"	Positive dispositions and attitudes relating to the role as part of educational communities
		National contexts in which the sub-indicators are relevant to:		
		Explicitly		
		Implicitly		
		Demonstration of epistemological awareness		
		GR,BG		
		Demonstration of positive dispositions to change, flexibility, ongoing learning and professional improvement (including study and research)		
		GR,BG,ES		
		Demonstration of critical attitudes to one's own teaching (examining, discussing, questioning practices)		
		GR,NL,BG		
		Teaching skills through content		
		NL,BG,ES		
		Transferable skills		
		BG		
		Commitment to promoting the learning of all students		
		GR,NL,BG,ES		
		Dispositions to promote students' democratic attitudes and practices, as European citizens (including appreciation of diversity and multicultural)		
		GR,NL,GR		
		Dispositions to team-working, collaboration and networking		
		GR,NL,BG		
		Sense of self-efficacy		

The ELITe project self-evaluation tool [3]

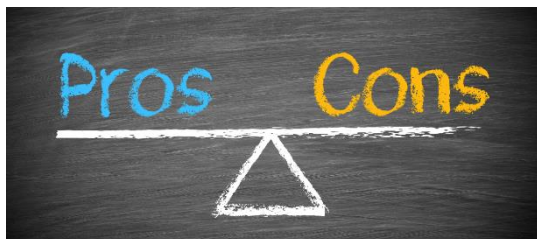
Table 3 Guidelines for structuring evaluation tool

Aim of the tool item	Dimensions	Example of tool item																								
To provide data for evaluating course assumptions	<ul style="list-style-type: none">- Relevance of the thematic to participants' needs- Relevance of learning through IBL methodology- Relevance of expected learning outcomes	<p>How relevant are the following to my professional learning needs: (1: not at all – 5: to a great extent)</p> <table><thead><tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr></thead><tbody><tr><td>Thematic of the module</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Learning through inquiry methodology</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Expected learning outcomes as in the module outline</td><td></td><td></td><td></td><td></td><td></td></tr></tbody></table>		1	2	3	4	5	Thematic of the module						Learning through inquiry methodology						Expected learning outcomes as in the module outline					
	1	2	3	4	5																					
Thematic of the module																										
Learning through inquiry methodology																										
Expected learning outcomes as in the module outline																										
To provide insights on participants' needs and expectations		<p>What is your motivation for participating in this course? What do you expect to gain from taking part in it?</p> <div>[open question]</div>																								
Evaluating the impact: To provide us with data on teachers' competence development	Knowledge & understanding	<p>Note: Refer to outcome indicators and sub-indicators from table 5 → <i>dimension knowledge & understanding</i></p> <p><i>Example:</i></p> <p>My knowledge and understanding on (indicative: implementing and assessing inquiry-based learning):</p> <table><thead><tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr></thead><tbody><tr><td>(1: very poor – 5: very good)</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Before the course was ...</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>After the course is ...</td><td></td><td></td><td></td><td></td><td></td></tr></tbody></table>		1	2	3	4	5	(1: very poor – 5: very good)						Before the course was ...						After the course is ...					
	1	2	3	4	5																					
(1: very poor – 5: very good)																										
Before the course was ...																										
After the course is ...																										
	Skills	<p>Note: Refer to outcome indicators and sub-indicators from table 6 → <i>dimension Skills</i></p>																								

				</	

Reflections on the applicability of the ELITE outcome indicators and the self-evaluation tool [4]

“The self-evaluation tool allows self-regulated learning and reflection on the learning goals” (GR)



“The self-evaluation tool is useful and usable by a broad range of potential users-teacher practitioners” (NL)

“The tool has the potential to stimulate self-directed and self-regulated learning as it supports setting and evaluating realistic goals and reflecting on the goals in the context of learning” (NL)

“The development of an online application of the self-evaluation tool is feasible, and it can be used in a variety of domains for professional learning of teachers” (NL)

“Both the outcome indicators document and the self-evaluation tool were found very convenient for the design of training activities by the participants of the Bulgarian workshop. The indicators and the tool are considered as directly applicable” (BG)

“Teachers seek to remain informed about the possibility of professional training that provides them with the necessary tools to meet the current requirements of the students” (ES)

“Participants were skeptical on the use of such instrument for formal assessment purposes in relation to their career progression; some of them pointed out their reluctance to be involved in any self-evaluation procedure” (GR)

“For learners who are used to have external assessment and validation frameworks and credits the tool might be considered as novel and conceptually not easy to be accepted; it requires effort, as it needs to be contextualized for use” (NL)

“The tool lack indicators about competence development for special-oriented learning and the impact of the methodology applied on learners’ self-effectiveness” (BG)

“Some teachers might not be willing to provide arguments or be decisive in the use of innovative teaching models” (ES)

Considerations/Recommendations for policy

- ✎ The description, definition and assessment of teachers’ professional competences is not simple, fixed or universal, but context dependent and subject to change. **National education policy should develop and promote competence frameworks, which take into consideration contextual aspects and are flexible enough to incorporate changes, as a response to new challenges emerging.**
- ✎ Educational policy should consider the **promotion of the use of context-based outcome indicators for teachers’ competence, as they are highly useful for the development of instruments for assessing the impact of STEM professional learning activities.**
- ✎ Teachers’ attitudes towards the assessment of their practice and the level of acceptance of assessment may vary among different educational contexts: in some EU contexts (for example in the Netherlands) teachers are used to have external assessment and validation frameworks and credits, while in others (for example in Greece) the culture of self-assessing professional practice is lacking. **Policy efforts to promote assessment of teachers competence development should ensure that there are common understandings on the purpose of assessment efforts and take measure for effective use of competency assessment instruments.**

Inquiry is a core term in the rhetoric of STEM educational reforms internationally. Almost thirty years of empirical studies investigating the impact of inquiry approaches has led to a comprehensive body of both empirical research and meta-analysis studies that provide evidence on the effectiveness of inquiry pedagogies in the development of science learning and the improvement of students' inquiry skills.

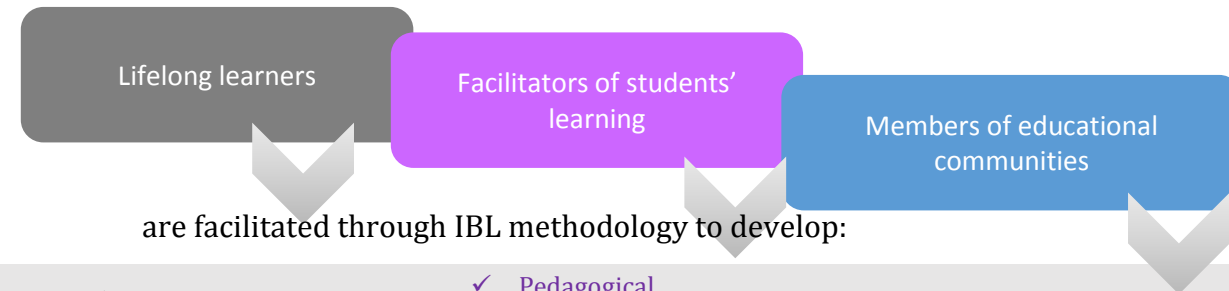
In ELITE, it is argued that *in recognizing the qualities of IBL as a means to promote learning and skills development to students, we also need to consider the potential of its effectiveness in STEM teachers' professional learning*. Under this perspective, ELITE has focused on the investigation of the inquiry skills being practiced by teachers in the course of STEM professional learning through inquiry approaches; it has sought to provide insights on the links between teachers' professional learning through IBL and teachers' competence development.

Cause and effect relationship between IBL activities and inquiry skills practicing [1]

		Contributed activities in the course				
		questioning	planning the method	review and analyze data	hand-on activity	communication
Believed practices skills in the course	critical thinking	✓	✗	✗	✓	✓
	information literacy	✗	✗	✗	✓	✗
	analytical skills	✗	✗	✓	✗	✓
	communication skills	✗	✗	✗	✓	✓
	digital skills	✗	✗	✓	✓	✗
	metacognitive and reflection skills	✗	✗	✓	✗	✓
	other research skills	✗	✓	✓	✗	✓

Effects of IBL methodology on teachers' competence development [1]

STEM teachers under their roles of:



Knowledge



- ✓ Pedagogical content knowledge
- ✓ Curricular knowledge

- ✓ Pedagogical knowledge
- ✓ Innovative STEM methodologies
- ✓ Evaluation and assessment

- ✓ Contextual, institutional & organizational aspects of educational policies

Skills



- ✓ Use, Develop and create research knowledge to inform practices
- ✓ Reflective and metacognitive skills

- ✓ Plan, manage coordinate teaching
- ✓ Use teaching materials and technologies
- ✓ Manage students and groups
- ✓ Monitor, adapt and assess teaching objectives
- ✓ Collect analyze and interpret data

- ✓ Collaboration skills
- ✓ Negotiation skills

Dispositions



- ✓ Flexibility ongoing learning
- ✓ Critical attitudes on own learning

- ✓ Teaching skills through content
- ✓ Transferable skills

- ✓ Positive dispositions to team working collaboration and networking

Critical issues affecting the feasibility of adapting IBL methodology in STEM CPD [2]

Greece

The IBL approach is still considered as a novelty in the Greek classroom reality and as such teachers are not familiarized with the methods. In addition, lecture-type teaching prevails teachers CPD provisions. However, IBL methodology was evaluated as of high relevance and attractive by teachers participated in the ELiTe project activities.

Netherlands

The IBL approach is widely accepted and used to young learners and as such teachers and teacher educators are familiar with the method. However, there is a movement in the Netherlands propagating “back to the basic education”. In addition, the stringent model based inquiry approaches might be a drawback and may lack feasibility. The above may influence the ELiTe model implementation in the country.

Bulgaria

The ELiTe IBL methodology for CPD was commented as extremely strong and innovative by the Bulgarian workshop participants. Highly valued characteristics: Learning through entertainment; learning through co-experience and co-design; getting into the shoes of the other; application of the scenarios in practice, motivation and interest. However, it is not clear how IBL methodology will have a place in teacher training curricula in which academic hours are reserved for lectures and exercises only. Also, a substantial part of school principals hold more traditional view on teacher training, and there is a danger that they will oppose to the introduction of innovative forms of teacher training in their schools.

Spain

Current educational policies focus on competency development, yet there is a low adaptation of IBL methodology at all educational levels. Also there is a lack of examples of good practice in IBL applied to STEM CPD programme. Teacher educators have found that the scenarios under IBL methodology developed by ELiTe is a good way to achieve active and constant teachers’ participation.

[1] Outcomes of the evaluation of the ELiTe approach, reported in the ELiTe project Intellectual Output O8. Access O8 in <http://learning-in-teaching.eu/index.php/en/intellectual-outputs/io8>

[2] Outcomes of the ELiTe projects Multiplier Events E5-6-7-8, reported in the ELiTe project Intellectual Output O10. Access O10 in <http://learning-in-teaching.eu/index.php/en/intellectual-outputs/io10>

Considerations/Recommendations for policy

- ✎ Educational policy should ***promote curriculum redesign of STEM professional development provisions*** not only in terms of content, but ***mainly in terms of training methodology***, considering that teachers are likely to reproduce to their classrooms the method they have themselves been trained (“teach as you preach” principle)
- ✎ The ELiTe project evaluation results provide strong indications that the Inquiry Based Learning (IBL) methodology is not only effective for young learners but applicable and effective in supporting STEM teachers’ competence development. ***Educational policy should consider the promotion of the IBL methodology in STEM teachers CPD contexts, and promote actions that assess its impact on teachers’ competence development, so as to increase the knowledge base for evidence informed implementations.***
- ✎ In educational contexts in which a more traditional form of STEM teachers CPD prevails, it is considered important that the educators of teachers get familiarized and get training themselves in innovative methodologies. ***Educational policy should take measures and support lifelong learning of teachers ‘educators and acknowledge and reward teachers educators innovative training initiatives.***
- ✎ School principals and leaders are considered key to ensuring the introduction of innovative forms of teachers training, especially in cases of school-based teacher training. ***Educational policy should promote knowledge sharing and negotiation initiatives at school level, in order to ensure acceptance of planned reform.***

The ELITE project approach for 21st century STEM teachers' professional development

What is next? Indicative actions proposed to educational policy

1 Towards place based approaches in STEM professional learning for competence development

2 Modernizing the thematic of STEM professional learning

3 Targeting towards the development and assessment of STEM teachers' competences

4 Utilizing the potential of IBL methodology for STEM teachers' competence development



- ✓ Identify critical issues in the national level that impede upon effective policy implementation using existing data or if necessary collecting new with a view to improve evidence-informed, place based policy making on STEM professional training.
- ✓ When designing national STEM CPD programmes, consider factors that have been identified as Europe-wide development trends in the field for quality, inclusive education (reference SDG4), especially considerations around STEAM and the crucial impact of previous experiences and parental attitudes towards STEM domains.
- ✓ Build on the existing knowledge base from current research in terms of effective forms of teachers CPD and practitioners' needs, and initiate negotiation processes with actors responsible for teacher training provisions, with the view to make professional learning content more relevant to STEM teachers' needs.
- ✓ Take measures for effective use of teachers' competence frameworks and competency assessment tools by teacher training providers through awareness development actions that ensure common understandings.
- ✓ Promote curriculum reform in terms of STEM Continuous Professional Development (CPD) methodological approach towards incorporating Inquiry Based Learning approaches, by supporting teachers' educators' capacity building on introducing innovative methodologies in CPD and promote actions that assess their impact.
- ✓ Ensured that school leaders and teachers are involved in reform initiatives and feel ownership of the policy, by setting-up mechanisms for providing feedback on implementing policies, promoting distributed leadership and widening the participation of school level stakeholders in decision making.