Supporting STEM teachers' professional learning for competence development

Insights on the space for intervention in *Bulgaria*

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The background

During the last decades, Bulgaria was faced with the need of dramatic changes in educational system and regulatory framework. The reform has started in 2010 and since 2016 is in effective use. The educational reform defines new profile of the teacher as a main actor in the educational process. In addition, the National Educational Standards about expected results of Science, Technology, Engineering and Mathematics (STEM) education, emphasize the development of the key competences. The change of the in-service teachers' knowledge, skills and attitudes, as well as professional life habits and behavior, in parallel with accepting of new understanding of teachers' responsibilities is a big challenge not only for teachers themselves but also for supporting institutions – Ministry of Education and Science, Regional Management Centers of Education, teacher training institutions and schools.

Against this background, this document aims to provide insights on the space for intervention for STEM teachers' professional learning in Bulgaria. Presented are results of work conducted in the frame of the ELITe project[1] pertaining to: the requirements for STEM teachers' competence development in the country - as evident in policy documents, teacher training curricula and students' curricula; the systemic opportunities/challenges and the aligned to them recommendations for supporting STEM teachers' professional learning - as emerged through a negotiation process between policy, policy mediators and STEM teachers. Presented results aim to serve as a basis under which educational stakeholders can reflect on and consider how best to support STEM teachers' professional learning for competence development in the country.

STEM teachers' competences in Bulgaria: Requirements & identified issues for consideration

A review of Bulgarian policy documents, STEM teachers training curricula and students' STEM curricula under the EC (2013) framework[2] resulted to the identification of the competences required by the Bulgarian STEM teachers ***explicitly*** – *as described in National Standards and implemented by policy mediation*, and ***implicitly*** - *as demonstrated in students' curricula*, which are presented here below. The *most emphasized aspects of competences* in the policy documents are ***highlighted.***

[1] **ELITe - Enhancing Learning in Teaching via e-inquiries** (2016-2019) is a European project, financed by the ERASMUS+ programme of the European Union Key Action 2 – Agreement No. 2016-1-EL01-KA201-023647.
ELITe aims to support STEM teachers' professional learning for competence development via inquiry methodology.

For more information visit the project website:
learning-in-teaching.eu

[2] http://ec.europa.eu/dgs/education_culture/repository/education/policy/school/doc/teachercomp_en.pdf

Knowledge & Understanding required…	*explicitly*	*implicitly*
Subject matter knowledge	✓	
Pedagogical content knowledge	✓	
Pedagogical knowledge	✓	
Curricular knowledge	✓	
Educational science foundations	✓	
Contextual, institutional, organizational aspects of educational policies	✓	
Issues of inclusion and diversity	✓	
Effective use of technologies in learning	✓	✓
Developmental psychology	✓	
Group processes and dynamics, learning theories, motivational issues	✓	
Evaluation and assessment	✓	
Innovative teaching method	✓	

Skills required …	*explicitly*	*implicitly*
Planning, managing and coordinating teaching	✓	✓
Using teaching materials and technologies	✓	✓
Managing students and groups	✓	✓
Monitoring adapting and assessing teaching/learning objectives and processes	✓	
Collecting, analyzing, interpreting evidence and data for professional decisions	✓	
Using, developing and creating research knowledge to inform practices	✓	
Collaborating with colleagues, parents and social services	✓	
Reflective, metacognitive, interpersonal skills for learning individually and in professional communities	✓	
Adapting to educational contexts	✓	
Life and Career skills: (Flexibility and adaptability; Initiative and self-direction; Productivity; Leadership and responsibility		✓
Key groups of transversal skill	✓	✓

Dispositions & Attitudes required …	*explicitly*	*implicitly*
Epistemological awareness	✓	✓
Teaching skills through content	✓	
Transferable skills	✓	
Dispositions to change, flexibility, ongoing learning and professional improvement, including study and research	✓	
Commitment to promoting the learning of all students	✓	
Dispositions to promote students democratic attitudes and practices as European citizens	✓	
Critical attitudes to one's own teaching	✓	
Dispositions to team working , collaboration and networking	✓	
Innovations in pedagogy	✓	

Prominent ***issues for consideration*** pertaining to systemic educational levels that were identified from the review of the Bulgarian national context through the documentary analysis include:

At policy level: **Opportunities and challenges in building teacher competences by the teacher trainings**

- Policymakers at national, regional and local level need to organize work together with traditional training providers (holding the methodology knowledge) and new one (holding concrete practical approach)
- Policymakers at all levels need to create conditions for IBL approach to be embraced by new teacher trainings providers (business, publishing houses, etc.)

***At policy mediation level*: Opportunities and challenges in schools management of strategy, curricula and teaching approaches**

- School authorities need to manage autonomy and freedom for decisions, and respectively – more responsibilities, so to use it to develop environment and space for application of the IBL

At practice level: **Teacher competence are needed to design IBL activities in the class. Teachers needs support for IBL day-to-day application. Content should be provided to spread widely the approach**

- Teachers need to build competences to design the education in IBL manner, to develop IBL scenarios and introduce them into day-to-day practice.
- Teachers needs support to design IBL activities.
- Content providers to respond to the new requirements of schools and teachers with new curricula and updated learning content interweaving the approach into it, and to be flexible for permanently changing requirements

Overall, the results of the documentary review make evident that there is a ***need to focus on the STEM teachers' training curricula and methods***, *on the awareness of* ***the role of different stakeholders in the teachers' competences development*** *and* ***the role of the teachers' competences for the development of new generation of Bulgarian youth***.

Emergent systemic opportunities and challenges for supporting STEM teachers' professional learning for competence development

The results of the documentary analysis were communicated and negotiated with policy makers, policy mediators (responsible for STEM teacher training) and practitioners in the course of the ELITe's project Bulgarian multiplier event[3] . The goal of the event was to discuss the topics above in constructive way leading to insights how to organize more effective STEM teachers' professional competence development. Participants first discussed the topics in homogeneous groups:

Policy makers were engaged mostly with the national standards on teachers' qualification, new obligatory topics for teachers' trainings, ways to receive feedback from teachers and broad society, requirements for teachers' annual working plan and students' textbook, how to deal with concurrency between teachers' training providers, i.e. how to assess (in advance and post-event) relevance and quality of particular teaching training course and / or teachers' training provider.

Practitioners discussed mainly administrative issues and how the administrative work can be done in more efficient and effective way; the need of relevant environment for STEM teaching – textbooks, simulations, specialized labs; the new subject in students' curricula, the new students' summative exams and how they corresponds with national standards of education; the teachers' attestation process – the period of attestation, who and how to choose particular trainings which particular teacher shell attend, what are aftereffects of attestation in

[3] The ELITe project multiplier event E3 took place on the 29 of June 2017 in Bulgaria with the participation of 43 national educational stakeholders. The event was conducted under the EASW workshop methodology, which *allows for interaction between stakeholders* and *aim for consensus building rather than instructional approach.* A report on the event can be found in: **learning-in-teaching.eu** (→ Outputs→Intellectual Output #3)

terms of teachers; carrier development, salary, penalty.

Broad society members were interested to the results of teachers' work and also commented the possibility of earlier graduating of students (10-th grade, approximately 16 year's old students) and joining the labor market. Another topic of interest was related to the lack of the motivated and qualified teachers in STEM disciplines of school, the new requirements for school-parent communication and sharing responsibilities.

The outcomes of the groups' discussions related to the new National regulatory framework, are summarized and presented as a Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis here below:

SWOT analysis of the National regulatory framework in accordance with teachers' competence development

Strengths	○ Opportunity for teachers' freedom to create new subjects and to implement new teaching methods and innovative training ○ Greater interest of the teachers to the qualification courses, better selection of the courses' topics ○ Opportunity for teachers to participate in training outside the country (e.g. CERN) ○ The existence of detailed regulatory framework make educational process more structured ○ Existence of the strongly defined system of teachers' assessment ○ Ordinance #13 on civil, health, ecological and intercultural education provides directions for STEM teachers work goals ○ Ordinance #12 on professional development of teachers, Section 5: Conditions and order of teachers', headmasters' and other pedagogical staff's qualification provide new possibilities for teachers' professional development ○ Availability of New Aspects – The Inclusive Education

Weaknesses	○ The consequences of teacher attestation upon their payment and career development are not regulated/defined. Lack of indication of what is happening at unearned 4 qualifying points upon the attestation of a teacher ○ Lack of choice for professional qualification ○ The standards for learning content are not well-formulated ○ Reduced number of hours in the science subjects. As a consequence – overburden of excessive study content for the class hours. ○ New curricula by subjects and lack of textbooks and study materials for them ○ There are no good conditions for out-of-class work of the teachers in school during the school day ○ Lack of equivalence among the different schools with respect to the National External Assessment; As a result part of the schools 'accumulate' lack of knowledge and fall behind in their educational process ○ Lack of differentiation for the (reasons of) absences of different types of students (talented students, competitions) – upon 25% or more of class absence in particular subject leads to compulsory after-school-year corrective exam, irrespective of the reasons for absenteeism ○ Lack of qualified teachers

○ Flexibility with regard to the school curricula. Opportunity for innovative practices through the school curricula. ○ Opportunity for new methods of teaching without criticism (punishment) by policy mediators or headmasters ○ Schooling with electronic materials, including dedicated for home use (School bags lightening) ○ Centralized Ministry of Education and Science (MES) to release e-forms for parents for different studies ○ Ensuring normal working conditions, consumables and equipment for the class work. ○ Team Buildings and Teacher training under a Differentiated Model ○ Cloud technologies and their role for better relationships with parents ○ "School for parents" ○ Opportunities for the innovative schools for new communication and relationships with parents and teachers ○ Verification of teacher competences by an independent organization. ○ Period and time for conducting qualifications gives opportunity for teachers to react to their professional needs. ○ The school curriculum (the learning plan - which the subjects how many hours to be studied) is year for year. This provide flexibility to change it the next year as a result of experiment ○ Distance education on special subjects ○ Future teachers – opportunity of training on Introducing and Working with Regulatory Documents. ○ Innovative schools – possibility for more flexible and creative new curricula (school learning plans and study programs by subjects) according to the school profile and vision	Opportunities

○ Many documentation – the Annual Thematic Timetables, etc. – a danger for burden with a not typical work to the teacher. Overloading teachers by duplication of paper- and electronic-based documents, with administrative duties ○ Poor correspondence between the MES and Higher Education (HE) regulations – they are applied differently ○ Illiteracy ○ Lack of control over the quality of teachers' training courses. There is a threat that different organizations, offering teachers' training courses, to offer low quality courses to attract more teachers by easily obtaining qualification credits. ○ Collecting certificates and a psychological test are a purely formal reporting and accounting ○ Some institutes 'produce' teachers, and it is not clear whether they (institutions) themselves have this right ○ Lack of external control for the pedagogical qualification – 'post-diploma qualification' and other forms ○ Selection of teacher training courses by the school principals on the base of the price of the training courses ○ Lack of willingness and interest by part of the parents to participate and support the school endeavors to educate their children (do not pay attention to the achievement of their children via the electronic diaries) ○ Lack of regulated funding for STEM education environment	Threats

The insights gained by the negotiation process between the educational stakeholders allows to support the argument that ***the new policy documents in the country provide much more flexibility and autonomy in decisions*** in front of all stakeholders' groups. At the moment not only the universities but also the science institutions, commercial and non-government organizations are eligible to offer teachers training courses, which ***raise the level of concurrency in terms of the thematic of offered courses and the quality of their design and implementation***. This stimulates the course providers to look for teachers' requirement on the qualification courses and to search the best way to respond to them. ***Teachers themselves, are encouraged by the policy framework to upgrade their professional qualifications through the attestation framework***, requiring gaining of at least one qualification credit each year, that recognizes not only participation in trainings but also ***active participation in experience exchange activities*** – workshop, seminars, open lessons, conferences, etc., and pro-active behavior as researchers - both scientific and practical - at a classroom level. The schools receive a dedicated ***financial support*** for teachers' professional development and also has a ***flexibility*** to organize internal trainings.

Critical issues on STEM teachers' professional learning for competence development in the country that emerged from the negotiation process are related to the ***content*** of the teachers' training courses, their ***form***, and *the* ***assessment*** of the courses and course providers and are presented below:

Emergent critical issues on STEM teachers professional learning in Bulgaria

In relation to the content of teacher training courses

- **STEM subject matter** – new science achievements as well as changes in the students' curricula. Special attention is dedicated to the use of ICT's in STEM disciplines education in terms of simulations of phenomena and dependencies, giving possibilities for students to experiment and generate hypothesis, reasoning, and conclusions. The use of professionally developed interactive digital learning resources and applications is much more important for schools where there is not labs for real experimental work.
- **Interdisciplinary** – practical trainings combining different STEM subject matter and relationships, in collaboration with other STEM subject teachers; learning design, implementation and evaluation of students' achievements.
- **Innovative teaching methods** – interactive methods of teaching / learning, design and implementation of student's inquiry, group work management, use of innovative ICTs in education, etc., focused to STEM education
- **Work with special students' groups**, tailored to the specifics of the subject and the educational need – involving students with special educational needs, work with talented students, and work with students with learning disabilities.
- **Work with parents** – effective communication and collaboration with parents, involving parents in school live, 'school for parents'.
- **Dealing with administrative issues** - familiarizing with administrative framework and approaches for more effectively carrying out administrative work
- **Evaluation in education** – approaches and technics for evaluation of educational process, how to implement classroom pedagogical experiment, evaluation of students'' textbooks and additional learning resources, formative and summative students assessments, etc.

In relation to the forms of teachers' training courses:

- ***Face-to-face or blended learning*** - Distance courses in a form of webinars are not efficient enough; face to face communication among trainees and between trainees and trainers is very important.
- ***Balance between learning at work place (school) and out the door courses***- regional, national workshops as environment for sharing ideas and experience. Active practical learning process is preferred by practitioners instead of lectures and formal exams. Also, demonstration and participation in innovative teaching methods implementation is very important for the successful transfer of given teaching methodology to the classroom.
- ***Online courses*** – as a current support, and as an archive for long term use. Training courses content online for future use is useful, as well as to have an online tool for support of the established professional community during the course.

In relation transparency and assessments of teachers' training courses:

The participants in the multiplier event were united around the idea of a common online platform offering:

- Information about teachers' training providers and information about teachers' training courses – topic, annotation, duration
- Transparent information about how many teachers attended a particular course and how they evaluate it
- Public ranking system of courses and public ranking system of course providers
- Possibility for users to inform the course providers for their needs and expectations of particular courses.

Policy recommendations towards supporting STEM teachers' professional learning for competence development

The critical issues on STEM teachers' professional learning for competence development in Bulgaria presented above were further discussed in the course of the EASW event, with the view to suggest proposals for enhancing STEM teacher' professional learning provisions.

The understandings gained from this process facilitated the formulation of the ELITe's project recommendations on how to support Bulgarian STEM teachers' learning for competence development.

The formulated recommendations are structured around two axes: the one aligned to the emergent critical issues on STEM teachers' professional learning for competence development in the country, and the other pertaining to the systemic educational levels. These are presented here below:

Recommendations aligned to the emergent critical issues

1 Modernization of the thematic of STEM teachers' training offers: focus on ICT in learning and teaching & interdisciplinary topics

There is a need of trainings on the new topics in the student's educational standards and curricula. For STEM teachers, very special topic of interest is **the use of relevant ICTs**, providing interactivity, that can compensate the limitations of school specialized labs (totally missing or poor of equipment). They need also practical courses related to the **interweaving of different disciplines**, providing ideas, design examples, and directions for students' achievement and the process assessments in implementation of interdisciplinary learning. They also need trainings on how to design, deliver and conduct an inquiry based learning on specific topics in specific grades.

2 Modernization of the teaching approaches of STEM teachers' training offers: interactive teaching methods and inquiry-based learning

There is a need of application of **modern teaching approaches** in teacher training offers. Special attention is dedicated to the interactive teaching methods which still are not very popular in Bulgarian system. For STEM learning disciplines there is a special need teachers to be trained on how to design, deliver and conduct **inquiry-based learning** process. **Teachers' training should be based on the same innovative learning methods which are expected teachers to apply in the classroom**, as opposite to the popular lecture-based teaching, traditional for long period in teachers' trainings in Bulgaria.

3 Inclusive education as a strategic priority for policy mediation providers

Inclusive education is a great challenge in front of Bulgarian teachers. The Bulgarian society still is not ready to integrate fully people with disabilities. This is a big challenge in front of the parents relaying on the school not only to provide the integration of the children with special needs, but also to teach parents how to deal with them. For teachers is very important to be familiarized with the specifics of most popular disabilities and difficulties and how they relate to their subject taught – how to organize the classroom, which learning activities are appropriate and which are not, is there a need of special tools and how to use them. The issue is a challenge in front of the teachers' training providers also as they also need to study best practices and experience in the field.

4 Provide training on how best to deal with administrative engagements

Teachers are overworked with administrative engagements, and they need training on how they can deal with them in a more efficient way.

5 Foster collaboration between teachers, parents and community stakeholders

Work with parents and broad society members is another weak point in Bulgarian educational system from past years and there is a need of training on how develop a good communication and collaboration between different stakeholders having attitude to the school life.

6 Enhance the assessment framework for STEM teacher training: focus on feedback mechanisms on skills development and teachers' practical work

Different forms of assessment and relative feedback is still a problem for teachers having practices mainly on the use of open/closed questions tests but there is a lack of skills in the evaluation of practical work, team work or inquiry-based learning and other innovative methods.

7 Promote blended learning in STEM teachers' training offers: face-to-face with a strong support of digital means for establishing professional communities

According to the **forms** of teacher' training, there is a need of development of strong network between STEM teachers, and between STEM teachers and trainers, so the preferable forms are a **face-to-face** and **blended** learning with a strong support of **online tools** for learning, communication, transfer to the classroom. The development of a national online platform for offering and rating the teachers' training courses and providers.

Recommendations pertaining to the systemic educational levels

Policy level

Building teacher competences by the teacher trainings: STEM learning content should be provided to spread widely the approach

- ☑ Policymakers at national, regional and local level need to organize work together of traditional training providers (holding the methodology knowledge) and new one (holding concrete practical skills)
- ☑ Policymakers and all levels need to create conditions IBL approach to be embraces by new teacher trainings providers (business, publishing houses, etc.) and teaching materials to be relevant to them
- ☑ Content providers need to respond to the new requirements of schools and teachers with new curricula and updated learning content interweaving the approach into it, and to be flexible for permanently changing requirements.

Policy Mediation level

Focus on schools management strategy, curricula and teaching approaches: Building stable relationships between different disciplines teachers and environment for common work, design and delivery of interdisciplinary projects, and effective application of ICTs in STEM education.

- ☑ School authorities need to manage autonomy and freedom for decisions, and respectively – more responsibilities, so to use it to develop environment and space for application of the IBL
- ☑ School managers need to support relationships with different institutions – museums, scientific labs, observatories, high-tech centers, etc.
- ☑ School managers need to support relationships between STEM teachers and interweaving of different disciplines during STEM education

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Practice level

Teacher competence are needed to design IBL activities in the class implementing inclusive education for students with special educational needs. Teachers need support for IBL day-to-day application.

- ☑ Teachers need to build competences to design the education in IBL manner, to develop IBL scenarios and introduce them into day-to-day practice.
- ☑ Teachers needs support to design IBL activities.
- ☑ Teachers need to be supported to deliver, manage and assess students' achievements during the IBL approach implementation.
- ☑ Teachers need to be supported to include students with special educational needs in fully valuable STEM learning process.

The above recommendations aim to provide a basis for the establishment of a dialogic process between policy, policy mediation and practice, towards a renewed approach and curriculum for STEM professional learning.

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