

Supporting STEM teachers' professional learning for competence development Insights on the space for intervention in *the Netherlands*

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The background

The national agenda on teacher professional development in the Netherlands is strongly influenced by policy envisions and discourse on new educational priorities such as development of 21st century skills, citizenship and civil society, inclusive education, education and training for yet non-existent professions.

Specific developments in Science, Technology, Engineering and Mathematics (STEM) domains have been driven by the necessity to enhance and further improve education in science and technology, better equip students for further studies in highly demanding technology enhanced domains, improve the image and stop falling numbers in science and technology in higher and further professional education in the country.

Against this background, this document aims to provide insights on the space for intervention for STEM teachers' professional learning in the Netherlands. Presented are results of work conducted in the frame of the ELITE project¹ 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 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 the Netherlands: Requirements & identified issues for consideration

In 2013, The National Technology Pact 2020 and a Platform Bèta Techniek were established as joint initiative of governmental institutions and industry. Among the objectives updated in 2016, are increasing the number of students with a STEM profile in general secondary education; provision of in-depth innovative advanced level education in Science and Technology through the increase of students choosing Science specialization in upper secondary schools and the introduction of *Technasium* as a new type of secondary school. Technasium offers in-depth curricula in STEM with a particular focus on Research and Development (R&D) as a core school subject and participates in developing regional networks involving Technasia, local industry, research centres and business.

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

The introduction of Technasia and new subjects in all STEM curricula stimulated professional learning initiatives at national, regional and grass roots levels such as development of shared Open Resource databases with teaching materials in a variety of subjects, including STEM, joint development of curricula for the new subject of Nature, Life and Technology in upper secondary schools, development of regional and national networks like Opeduca or Jet-Net.

Introduction of Science and Technology in primary education curricula is another important consequence of the National Technology Pact 2020 with direct implications for teacher competence development and in-service teacher education for primary schools.

Among other initiatives, Ministry of Education and the Platform Bèta Techniek has introduced a programme supporting several STEM teachers a year in doing fundamental research in their discipline through the system of internships. By doing research teachers get new sources of inspiration for their teaching practice and can make link between science and practice.

A review of Dutch policy documents, STEM teachers training curricula and students' STEM curricula under the EC (2013) framework² resulted to the identification of the competences required by Dutch 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.

Requirements for STEM teachers' competence development in the Netherlands



| 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 methods | ✓ | |

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



Skills required ...

| | <i>explicitly</i> | <i>implicitly</i> |
|------------------------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|
| 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 ...

| | <i>explicitly</i> | <i>implicitly</i> |
|------------------------------------------------------------------------------------------------------------------|-------------------|-------------------|
| 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 Dutch national context through the documentary analysis include:

At policy level: Balance between societal demands of innovation, the national core curriculum requirements and the organization of pre-service and in-service teacher learning and permanent competence development in STEM domains.

- The pre-requisites for sustainable teacher learning and competence development against the newly defined teacher competence quality standards and beyond them

At policy mediation level: Transition from pioneer work, experiments, projects and lessons learned from them to integration of innovative approaches at schools into mainstream school daily practice against the background of the current practices of teacher learning facilitation by school boards.

- Ensuring that innovation and teacher professional learning innovate and transform the current school practice and vice versa that innovative practice insures sustainable teacher learning.

At practice level: The impact the new trends implicate for teacher professional learning and competence development and the implications they have on the school practice.

- Integration of 21st century skills with (STEM) domain knowledge and skills, connecting learning in and out of school with ubiquitous ICT (seamless learning idea), integration of subjects, learner directed curricula - numerous trends meet in the school of today and make active teacher involvement in designing and shaping his/her lessons, courses and curricula for and with learners a necessity.
- Insights in what works and why are needed to underpin design decisions, therefore the inquiring mind as an attitude comes into picture.
- Teacher as designer and teacher as inquirer /researcher of his/her own practice are two important trends in the teacher profession nowadays.

Overall, in the Dutch context, the main issue identified from the documentary analysis lies on ***the impact of teacher learning for competence development on the school practice***. Proposed topics for further exploration and discussion are:

- ***teacher professional learning and competence development against the newly defined teacher competence quality standards, societal demands and beyond them;***
- ***innovative trends (new technologies, new approaches to teaching and interaction with learners and their impact on school practice at school level;***
- ***innovative trends (new technologies, new approaches to teaching and learning and their impact on school practice at the level of lessons and student – teacher interaction.***

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

The proposed topics for further exploration and discussion that were identified by the analysis of national policy documents were communicated and negotiated with educational stakeholders in the course of the ELITE's project Dutch multiplier event³. The aim of the event was to validate the results of the documentary analysis, and to gain insights from policy mediation representatives and practitioners on how to support more effectively STEM teachers' professional learning for competence development.

Outcomes of the Dutch multiplier event demonstrate that professional learning is a relevant issue in Dutch educational discourse and that designing, organizing and orchestrating professional learning is a complex task that can be best tackled in a manifold way. A preliminary online questionnaire completed by participants showed that ***learning in relation to the job context is relevant yet versatile – there is a need in formal knowledge, skills and work related collaborative activities***, however, the participants pointed to needs that are specific and work related and needs that are more abstract and related to general competence growth. Collection of input from the workshop discussions confirmed this conclusion: ***needs in professional learning are versatile and are related to both specific issues as to general competence development perspective.***

An outline of the needs for professional learning as expressed from workshop participants is presented here below. Prominent are the ***need in facilities at the workplace and collaboration***, being able to ***communicate and collaborate with colleagues at the workplace and outside.***

³ The ELITE project multiplier event E2 took place on October 5, 2017 in the Netherlands, as an integral part of a regional large-scale event, the so called Teacher festival. The event was conducted under the EASW workshop methodology, which allows

for interaction between stakeholders and aim for consensus building rather than instructional approach & the Group Concept Mapping methodology. A report on the event can be found in: learning-in-teaching.eu (→ Outputs→Intellectual Output #3)

In professional learning activities teachers need:

➤ Facilities for professional learning

Support and time for learning (taking courses), more time to develop lessons; trust and independence in designing and implementing lessons

➤ Informal learning support

Use of daily practice as a source of professional learning; more opportunities to learn from each other; Coaching at workplace on effective teaching

➤ Interaction and exchanges with colleagues

Exchange of experiences, talking to colleagues, meeting colleagues, brainstorm about tasks with others

➤ Peer feedback and consultation

Asking feedback/getting feedback from colleagues; more supervision by colleagues; visiting each other lessons; open door policy

➤ Collaboration

Joint work on learning environment; collaboration and exchange of ideas with colleagues from other schools; sustainable models of knowledge sharing

➤ Access to knowledge

Lecture, courses, training and experience in ... new pedagogies, socio-emotional development, new teaching methods, and behavioral disorders of schoolchildren

➤ Doing Research

Together colleagues setting up experiments and study what works; more inquiry based reflection on the teaching process

➤ Organizational changes

Changing school organization; making school an organization for professional learning, less control, more autonomy and trust, less administrative workload

➤ 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 skill

Learn to motivate students; develop better digital skills; time management skills

An offer of professional learning trajectories that caters to these needs is **both a challenge and an opportunity** to contribute to teacher professional development in an effective way.

Input collected from the workshop also pointed out to several specific themes that are of interest as anchors in professional learning events for teachers interested in innovative pedagogies such as inquiry based learning. ***There is interest in new concepts and tools while the relevance of application of the new knowledge in the classroom, in one's professional practice can be seen as a predictor of whether professional learning events introducing such tools and approaches will effectively contribute to teacher competence development*** in general and in STEM-related disciplines in particular.

Specifically, ***challenges STEM teachers face on integrating inquiry-based learning methodologies*** in their classrooms – which is a prominent issue for consideration in the Dutch context - as emerged from the negotiation process include:

For **teachers**:

- Dealing with diversity
- Personalized teaching, differentiation
- Monitoring process, getting all students participate
- Acting as a coach, supporting students finding answers
- Assessment of outcomes at different levels for different students skills
- Finding time to organize a learning setting for inquiry based learning

For **students**:

- Collaboration, planning, inquiry mindedness, self-regulation, ability to learn and understand what is implied
- Formulating good learning questions
- Discovering what is possible, going beyond the given task, getting from idea to results
- Working technology

Professional learning activities that aim to tackle the above mentioned challenges are of prominent importance according to the event participants.

Another issues emerged from the negotiation process concerns the importance of **offering opportunities for collaboration, joint work and sharing of one's own practice**. Taking a look into each other's "kitchen", learning from each other is considered most relevant by participants of the multiplier event. However, facilitation of learning by school management, allocating time for professional learning activities is an aspect that cannot be tackled by a provider of a learning event. **Investing in long-term cooperation with school boards and school management is an important pre-requisite for an institution engaged in development of professional learning activities**. This implies that responding to the needs of school boards, collaboration in organizing events is an integral part of the offer of such learning events.

In relation to the opportunities for teachers' competence development in the country, **collaboration at regional level offers a good opportunity to create long term relationships between educational research and technology development and the teacher practice** on the one hand, and is a guarantee that educational and training activities designed and delivered within the Elite framework will not be one-time activities. The alignment between the offer and the experienced needs in learning activities increases the chance that the intervention will indeed help change and further develop the instructional practice.

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

On the basis of the collected input of the Dutch ELiTe event and taking into account the outcomes of the review of the national context through the documentary analysis, the following recommendations on how to support Dutch STEM teachers' learning for competence development are formulated, pertaining to the systemic educational levels.

The following 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.

Recommendations pertaining to the systemic educational levels

Policy level

Alignment with the national framework is both relevant and necessary

- ☑ All learning activities need to be part of the national professional learning requirements (lerarenregister) to realize this alignment

Policy Mediation level

School management should be responsible for facilitating learning, allocating time for it and creating pre-requisites.

- ☑ School boards are partner in the organization of learning activities and are responsible for facilitation learning at the workplace

Practice level

Introduction of new technologies and approaches should be part of both learning and teaching practice. Support is needed in both.

- ☑ Learning events should be linked to teaching practice or be easily transferrable to it
- ☑ Teachers are owners of their designs that they can develop in the learning situation and try out in their own practice.
- ☑ Exchanges with other teacher on their hands-on experiences is a valuable part of learning for teaching.



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