Education through and in Natural Sciences

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These days, the statement that natural education, as do music, literature or philosophy, belongs to general knowledge is agreed. As part of our cultural heritage, natural sciences lay the foundations for the future of humanity. Pending difficult decisions as regards climate policy, medicine, digital turnaround call for the scientifically mature citizen.

The European Commission has published a European Qualification Framework (2006) for lifelong learning with eight key competences – among others basic scientific and technical competence as well as the computer competence. It is "the ability and willingness to explain the natural world on the basis of existent knowledge and certain methods in order to ask questions and to draw conclusions based on evidence." Required are knowledge (basic principles, methods) abilities (concepts) and attitudes (critical recognition, curiosity, respect). In sum, the European Commission (as well as the OECD: PISA) encourages „democratic citizenship in a climate of rapid change due to the threat of alienation. It requires people to be informed and concerned about their society and participate. The knowledge, skills and aptitudes that everyone needs must change as a result.“

With regard to this education, we need to ask what are the basic principles, the scientific concepts, the principles and methods that are part of this ability to explain the world? The Common Framework of Reference for the Natural Sciences (Gemeinsamer Referenzrahmen für Naturwissenschaften (GeRRN) von MNU (Verband zur Förderung des MINT-Unterrichts) (Association promoting the teaching of STEM) accepts the responsibility to fill the gap above mentioned.

The selection of competences is based on structures and concepts (learning lines) (GDNÄ, 2007), fold immanent based on each other. It enables the learner to read the world understandingly (MNU, 2003), contemporary and future meaning in examples (Klafki). To create a complete canon of all scientific contents would however be presumptuous and ineffective. Much more it is always irrevocable to negotiate the canon under a didactic and social point of view. The present document has the goal of achieving this across Europe.

The tried and tested "Common European Framework of Reference for Languages" (CoFRL) is the role model. It has proven it´s functionality. It enables to qualify competences in languages on the base of different levels.

In analogy to the CoFRL, the CoFRNs is not an educational plan. This new approach does not specify which lessons and topics should be taught in the classroom and which competences should be acquired, as in a curriculum, but rather defines which natural science competences need to be found in our society, graded according to five different levels.
Certificates, supported by differentiating tasks, should confirm the respective

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natural competences. Each individual has his or her own depth of penetration into the understanding of natural science.

In view of the tremendous cognitive growth as well as the plurality of heterogeneous discourses this demand to an autonomous citizen is getting more difficult. On the other hand, lifewordly concepts (of every day life) remain the same. Connecting to the internal world of the learners, on their narrative relationship to themselves as well as to their understanding of the world, we extend the educational demand of the CoFRNs to transformation and changes of perspective, metaphorically the change of their glasses (MNU, 2003). This request does not only mean content, functional, formal education. There are high demands on reflexivity, autonomy, and internal consistency of the life-long learners, ultimately with regard to their beliefs and attitudes. Therefor teaching has to change itself.

The present document has the goal of making this possible across Europe:

- Strengthening natural sciences as part of the cultural heritage of humankind in both school and society.
- Strengthening the functional, reflexive and transformative general knowledge.
- The decisive criterion in the selection of natural competences should be their relevance for applying natural sciences as well as reflectiveness.
- Development of certificates of education in natural sciences, independent of the educational path.
- Strengthening the development of a sustainable science education by securing the particular level achieved.

This presentation of the main aspects of the Common Framework of Reference for the Natural Sciences (Gemeinsamer Referenzrahmen für Naturwissenschaften (GeRRN) von MNU) should lead to an intensive discussion. Because we would very much appreciate getting feedback by other European countries and by the member of the ECTN.

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