

## **Driving value-based STEM education: “We’re sitting on a goldmine in terms of future development.”**

On March 27, 120 educational researchers, politicians, educators and parent representatives from all around Germany spent the day holding energetic discussions on how to promote values in science and technology education. The event in question was Siemens Stiftung’s interdisciplinary and multi-perspective conference held at the Gaszählerwerkstatt events space in Munich. The title of the conference was “STEM and Values – How Values Can Be Taught in Schools”.

Why would Siemens Stiftung initiate such a forum under the patronage of the Standing Conference of Ministers of Education and Cultural Affairs and in cooperation with the Karlsruhe Institute of Technology? The non-profit corporate foundation has been involved in and committed to value-led teaching and learning for many years through its international educational work. This commitment has been important and fundamental since there have only been very few teaching methods, until now, which promote technical knowledge and at the same time strengthen students’ ability to form values. The speeches, rounds of discussions and conversations held at the conference highlighted the real need to embed the promotion of values in science and technology school subjects and to ramp up the application of those values in educational and didactic practice.

Chaired by the education expert and journalist Lothar Guckeisen, there was an energetic exchange regarding the conditions under which values can be successfully promoted within STEM education and what needs be done to support this at academic, political and educational level. Dr. Nathalie from Siemens, Managing Director and spokesperson for Siemens Stiftung, really got to the crux of the matter in her opening address, saying: “There is huge potential in combining STEM education and values together, not only for individuals but also for further developing society at large. We’re sitting on a goldmine in terms of future development!”

As part of 12 focus rounds, participants from all over Germany worked on the conditions required to ensure success and the need for action in practice. The results provided valuable impetus for the concluding fishbowl discussion during which specific fields of action were identified for the successful promotion of values within education. There was consensus amongst all participants that issues regarding values should be more heavily integrated into science and technology subjects. However, in practice, there is often a lack of time and financial resources. The conference presented solutions that could be implemented both as part of further training for teachers and in teaching practice, such as methods for promoting values as part of joint experimentation, materials for inclusive discovery-based learning, promoting values with the form of instruction and learning known as Service-Learning and opportunities for using serious games.

## Topics & Speakers

How can ethical values be successfully promoted in STEM subjects? Different perspectives were considered and various formats were used to formulate the conditions required to ensure success and define the actions required. The following serves as documentation of all contributions and discussions.

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### ***“Not only is knowledge built but social personality is called for here.”***

What makes us human? In her welcoming address, Dr. Nathalie from Siemens opened with a thought-provoking philosophical question about the uniqueness of the human condition: What factors and what perspectives are decisive? Our moral concepts and moral stances are not only special characteristics that set us apart, but also educational capabilities. The importance of successful value promotion is therefore extremely significant in terms of individual development. The most important thing here is that values should be conveyed and imparted during children’s early formative years as part of real life and in relation to everyday life as much as possible. This is where STEM education comes in: “Anyone dealing with science and technology issues will not be able to avoid reflecting on them, making assessments and taking decisions.” As a result, there is no need for new subjects to be introduced: “The didactic approaches simply need to be shaped accordingly.” New approaches are therefore required, such as discovery-based learning, combined with value-based issues.

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### ***“Democratic education needs to be taught through all subjects.”***

Heidi Weidenbach-Mattar, the Permanent Representative of the General Secretary of the Standing Conference of Ministers of Education and Cultural Affairs, stressed in her opening words that democratic education needs to be taught through all subjects. She also identified how methods of science and technology education can promote values: “An experiment usually requires people to work as a team, pool ideas to come up with possible solutions, discuss various directions to take, come together and agree on a promising solution and last but not least show proper consideration for one another. This is particularly the case when dealing with substances which could be hazardous if not handled with care. Values become tangible and perceptible without having to be specifically broached.”

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### ***“Having values is one thing but you also need to live by them.”***

What responsible correlation is there between science, technology and values in research practice and what does that mean for school-based STEM education? Professor Manfred Prenzel, Educational Researcher and former Chair of the German Council of Science and Humanities, posed those questions as the key focus of his captivating keynote speech. In it, he explained that values support STEM education by enriching it and providing areas for reflection. “We need to pick up on contentious issues in STEM education. Students are interested in dealing with current and also critical issues.” Manfred Prenzel used a conceptual insight into basic science education to show how science can be valued much more strongly from a student’s perspective. However, at the end of his speech, he

emphasized that, overall, it's not just about having knowledge about values but also putting those values into action. Prenzel recommended strengthening forms of instruction and learning like Service-Learning as value-oriented and STEM competent action. "We need to focus on responsibility as a topic within schools and implement it in practice."

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***"Basic values need to be learned through experience."***

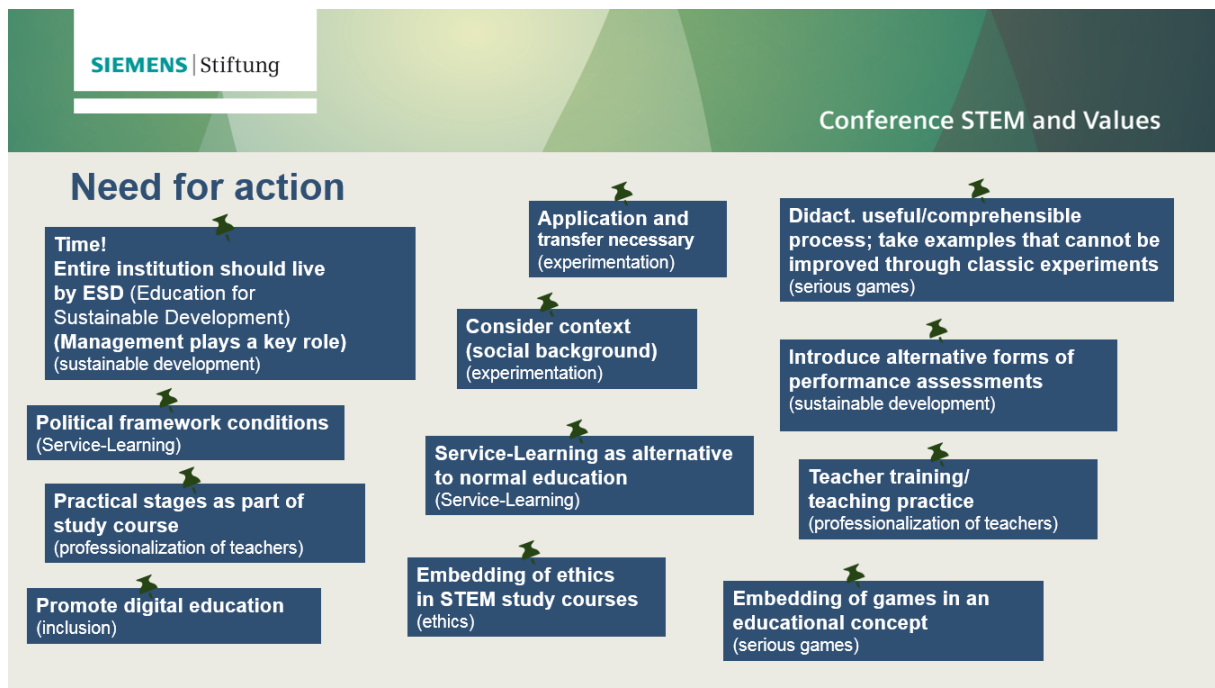
"How do children and adolescents form values?" This question was discussed by four renowned experts: Prof. em. Dr. Hans Bertram from the Humboldt-Universität zu Berlin, Prof. Dr. med. Hans-Jochen Heinze from the Clinic for Neurology at the University Hospital Magdeburg, Prof. Dr. Monika Keller from the Max Planck Institute for Human Development in Berlin and Prof. Dr. Wilfried Schubarth from the University of Potsdam. According to them, children enter school with a fixed framework of values on account of their neurophysiological predisposition and socio-psychological early development. As a "value space" (school curriculum, general principles and education), the school accelerates or adjusts the formation of certain values. With regard to the role of teachers, it is important that, firstly, they themselves are aware of and understand the term "value promotion" and, secondly, that they have the resources to integrate value-building teaching into children's education. What is decisive here is the method: "Basic values need to be learned through experience." When someone truly understands what is right, then they will also behave in accordance with that", argued Prof. Dr. Monika Keller.

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***Experiencing instead of preaching***

As part of 12 interactive focus rounds, the participants worked on the conditions required to ensure success and the need for action in practice. They discussed and reflected on methods for promoting values during joint experimentation, approaches for inclusive discovery-based learning, the promotion of values with the form of instruction and learning known as Service-Learning or in accordance with the concept of education for sustainable development as well as opportunities to use serious games. They also focused on the professionalization of teachers and prospective teachers in the promotion of values, and the role of ethics in science study courses.

The following slides show conditions required to ensure success and the need for action:



***“You gain more knowledge by applying values.”***

The results of the focus rounds provided valuable impetus for the concluding fishbowl discussion “Conditions required to ensure success and the need for action for the promotion of values in STEM education”. Heinz Lingen, Educational Managing Director at Haus Overbach and former Headmaster of the secondary school, em. o. Univ.-Prof. Dr. Jean-Luc Patry, Department of Educational Science, University of Salzburg, Dr. Ulrich Seiser, Bavarian State Ministry of Education and Cultural Affairs, Science and the Arts, Stephan Wassmuth, Chair of the German Federal Parent Council as well as Dr. Nathalie from Siemens highlighted specific fields of action for the promotion of values in education. The conditions required for the successful implementation of that are more exemplary teaching units with a focus on values and a fundamentally stronger connection between value-based action and science and technology education. “You cannot impart values but only create situations in which students construct values for themselves”, argued the Educational Scientist Jean-Luc Patry. A lack of resources and insufficient teacher training were named as the most pressing areas in need of action. This is where help is needed in the future and pioneering examples and impetus from the conference need to be put into practice. As Patry concluded: “You do not lose but gain more knowledge by applying values.”

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**For more information, please contact:**

Christine Niewöhner / [christine.niewoehner@siemens-stiftung.org](mailto:christine.niewoehner@siemens-stiftung.org)