全球STEM教育采访提纲

Interview – Prof. Dr. Christoph Meinel, German UDS

1. 随着新一轮科技革命和产业变革加速演进，全球可持续发展和劳动力市场面临严峻挑战。作为未来创新型数字科技人才培养的重要手段，大力发展STEM教育有利于全球携手应对人类面临的共同时代课题。9月21日，联合国教科文组织国际STEM教育研究所在上海正式成立，这是全球STEM教育发展的里程碑事件，将为推动全球STEM教育的交流合作，为广大发展中国家发展STEM教育提供更有力的支持。您认为这一研究所在中国设立的意义是什么？

1. As the new technological and industrial revolution accelerates, global sustainable development and labour markets face significant challenges. Vigorously advancing STEM education is a vital means of cultivating future talent in innovative digital technology and facilitating global collaboration in addressing the common challenges facing humanity. On 21 September 2025, the UNESCO International Institute for STEM Education was formally established in Shanghai. This significant event in the development of global STEM education will promote international exchange and cooperation in STEM education, providing stronger support for developing countries to improve their STEM education systems. What significance do you attribute to the establishment of this institute in China?

2.在您关注的 STEM 教育阶段，全球范围内呈现一种什么样的趋势？普遍存在的共性问题是什么？不同经济发展水平的国家面临的差异化挑战有哪些？

2. What emerging trends can you identify within the STEM education stage you focus on? What common challenges are encountered? What differentiated challenges do nations at different levels of economic development face?

3.从您的专业领域出发，您认为当前全球 STEM 教育人才培养的 “核心能力框架” 应包含哪些维度？与五年甚至十年前相比，这些能力的优先级发生了怎样的变化？

3. Drawing upon your professional expertise, which areas should the ‘core competency framework’ for cultivating global STEM talent cover today? How have the priorities of these competencies changed compared to five or ten years ago?

4. 您所在机构或主导的项目中，有哪些经过实践验证的 STEM 教育创新模式？这些模式在不同文化背景或教育体系中推广时，需要进行哪些适应性调整？

4. What evidence-based, innovative STEM education models exist within your organisation or the projects you lead? What adjustments need to be made to these models when they are scaled up and applied in different cultural contexts or educational systems?

5. 在

STEM人才培养中，政府、教育机构、企业、国际组织应如何明确分工与协作

？目前哪些协作机制已初见成效，哪些仍存在改进空间？

5. How should governments, educational institutions, enterprises and international organisations define their respective roles in cultivating STEM talent and collaborate? Which collaborative mechanisms have shown initial effectiveness, and in which areas is there room for improvement?

6. 针对 STEM 教育中的

“公平性难题”，如性别差异、地域资源差距、特殊群体教育保障等您认为最亟待解决的问题是什么？有哪些可落地的干预措施？

6. What issues do you consider most pressing regarding the ‘equity challenges’ in STEM education, such as gender disparities, regional resource gaps, and educational safeguards for special groups? What actionable interventions are available?

7.如果用三个关键词概括全球 STEM

教育的未来方向，您会选择哪三个？为什么？

7. If you had to summarise the future direction of global STEM education using three keywords, what would they be? Why?

8.国际合作是应对全球共同挑战的重要路径。您觉得如以联合国教科文组织国际STEM教育研究所落户上海为契机，进一步如何加强国际合作？

8. International cooperation is vital for addressing shared global challenges. Taking the establishment of the UNESCO International Institute for STEM Education in

Shanghai as an opportunity, how might we further strengthen international collaboration?

Answers by Prof. Dr. Christoph Meinel

President of the German University of Digital Science

Question 1:

As the new technological and industrial revolution accelerates, global sustainable development and labor markets face significant challenges. Vigorously advancing STEM education is a vital means of cultivating future talent in innovative digital technology and facilitating global collaboration in addressing the common challenges facing humanity. On 21 September 2025, the UNESCO International Institute for STEM Education was formally established in Shanghai. This significant event in the development of global STEM education will promote international exchange and cooperation in STEM education, providing stronger support for developing countries to improve their STEM education systems. What significance do you attribute to the establishment of this institute in China?

Prof. Dr. Christoph Meinel:

The establishment of the UNESCO International Institute for STEM Education in Shanghai is highly significant both symbolically and practically. It reflects China's growing role in global education and technology governance while offering a platform for international cooperation to strengthen STEM education worldwide, especially in developing countries.

Advancing Global STEM Collaboration: By situating the institute in Shanghai, UNESCO emphasizes the importance of cross-border collaboration in STEM education. It creates a hub where experts, educators, and policymakers can share best practices and promote inclusive innovation. The institute provides a neutral platform for fostering dialogue between developed and developing countries, facilitating joint projects and research on global challenges such as climate change, AI ethics, and sustainable industrialization.

Supporting Developing Countries: The new institute will help bridge the gap between nations that have advanced STEM education systems and those still developing theirs. It can provide technical assistance, teacher training, and curriculum development support, strengthening educational infrastructure in regions where shortages of STEM expertise hold back innovation.

Symbolism of Location in China: China's rapid advancements in digital technology, engineering, and green energy make it a strategic choice for hosting the institute. It signals recognition of China as a leader in applying STEM to sustainable development issues. Locating the institute in Shanghai, a global financial and innovation hub, reinforces the connection between education, technological progress, and global economic transformation.

Contribution to Global Sustainable Development Goals: STEM education is essential to achieving the United Nations' Sustainable Development Goals (SDGs), particularly those related to quality education, industry innovation, and climate action. The institute can serve as a bridge linking education policy with sustainable development priorities, ensuring that future STEM talent is equipped to address pressing global challenges.

In essence, the institute's establishment positions STEM education as a cornerstone of global development, while elevating China's role as both a beneficiary and a facilitator of international educational cooperation.

Question 2:

What emerging trends can you identify within the STEM education stage you focus on? What common challenges are encountered? What differentiated challenges do nations at different levels of economic development face?

Prof. Dr. Christoph Meinel:

The latest stage of STEM education is characterized by rapid technological integration, a shift toward experiential learning, and a global drive for greater equity and access. Common challenges include achieving educational equity, bridging digital divides, and preparing educators to deliver dynamic, tech-driven curricula. Nations with different economic development levels encounter unique obstacles, ranging from access to basic resources in developing countries to workforce alignment in advanced economies.

Key Emerging Trends:

(i) AI, VR/AR, and robotics are transforming STEM instruction and assessment, enabling personalized, adaptive learning experiences.

(ii) Project-based and experiential learning models are replacing traditional lectures, with a focus on addressing real-world problems and fostering innovation.

(iii) Interdisciplinary STEAM approaches (integrating arts) spur creativity and broaden participation in STEM fields.

(iv) Flexible credentials (such as micro-credentials and stackable certifications) are gaining popularity, allowing learners to tailor their educational pathways to evolving job market needs.

(v) Global collaboration is intensifying, with cross-border projects, international networks, and open-access resources enriching the STEM education ecosystem.

Common Challenges:

(i) Equity and Inclusion: Addressing gender gaps, socioeconomic disparities, and unequal access to technology and high-quality curriculum remains a central concern worldwide.

(ii) Teacher Preparation: The need for ongoing professional development and support for educators is crucial for adapting to new technologies and pedagogical models.

(iii) Digital and Resource Divides: Many students and schools lack reliable internet, devices, or lab equipment, hindering full participation in tech-powered learning.

(iv) Curriculum Relevance: Aligning STEM instruction with future workforce needs and rapidly shifting technological landscapes is challenging for educational systems.

Question 3:

Drawing upon your professional expertise, which areas should the ‘core competency framework‘ for cultivating global STEM talent cover today? How have the priorities of these competencies changed compared to five or ten years ago?

Prof. Dr. Christoph Meinel:

(i) The core competency framework for cultivating global STEM talent today should cover the following key areas:

(ii) STEM Literacy: Mastery of foundational and specialized knowledge and skills in science, technology, engineering, and mathematics; ability to solve real-world STEM problems; effective communication of STEM concepts across stakeholders.

(iii) Integrated STEM Curriculum Development: Ability to design interdisciplinary curricula combining multiple STEM disciplines, aligning learning outcomes, content, teaching methodologies, and assessments.

(iv) Student-Centered Teaching and Learning: Proficiency in active, experiential, and inquiry-based learning methods that foster collaborative and inclusive STEM learning environments.

(v) Assessment and Adaptation: Competence in designing, implementing, and adjusting assessments for integrated STEM education to evaluate learning outcomes effectively.

(vi) Attitudes and Mindset: Positive attitudes toward lifelong learning, innovation, collaboration, and fostering confidence and interest among students in STEM fields.

(vii) Digital and Advanced Skills: Incorporation of advanced digital skills such as data science, algorithmic literacy, computational thinking, cybersecurity, and emerging technologies relevant to the STEM workforce.

(viii) Professional Development and Industry Collaboration: Continuous upskilling and reskilling linked to industry needs, entrepreneurial skills, innovation management, and engagement with real-world STEM ecosystems.

Regarding the changes in priorities compared to five or ten years ago:

(i) The emphasis has shifted from isolated discipline knowledge toward more integrated, interdisciplinary STEM education frameworks that reflect real-world complexity.

(ii) Student-centered, active learning strategies and competence-based assessment have become more central.

(iii) Advanced digital skills and technological literacy have gained prominence due to rapid technological advances.

(iv) There is increased focus on diversity, inclusion, and attracting underrepresented groups.

(v) Collaboration across education levels, industry, and innovation ecosystems is prioritized to ensure relevance and agility in STEM skills development.

(vi) Lifelong learning and professional development frameworks are now core to sustaining STEM talent pipelines as career landscapes evolve rapidly.

Thus, the competencies reflect a more holistic, dynamic, and context-responsive approach than the more discipline-specific, knowledge-focused frameworks that dominated a decade ago.

This summary builds on recent integrated STEM education competence frameworks for educators and strategic plans for STEM talent development, especially in the European context in 2025.

Question 4:

What evidence-based, innovative STEM education models exist within your organization or the projects you lead? What adjustments need to be made to these models when they are scaled up and applied in different cultural contexts or educational systems?

Prof. Dr. Christoph Meinel:

Evidence-based innovative STEM education models prominently include integrated and interdisciplinary approaches such as the STEAM+H model, which incorporates humanities, arts, and ethical principles alongside traditional STEM disciplines to foster creativity, social responsibility, and sustainable development outcomes. These models emphasize real-world problem-solving, project-based learning and the use of advanced technologies like virtual and augmented reality for immersive, hands-on experiences. They also prioritize developing 21st-century skills including critical and design thinking, teamwork, and digital literacy, adapting to learners' age and cultural context. A core feature is adaptability to local contexts, targeting inclusiveness and relevance across diverse student populations.

Another widely recognized model is Integrated STEM Education (iSTEM), framed by social constructivist learning theory. Its key principles focus on the integration of STEM content, real-world problem orientation, inquiry, design, teamwork, and student-centered, hands-on learning. This model also highlights the importance of scaffolded inquiry and design-based learning tailored to disciplinary perspectives (e.g., science vs. engineering) and emphasizes cooperative work to reflect authentic workplace demands.

Scaling these models across different cultural contexts and educational systems requires several adjustments:

(i) Localization of Content: Curricula and problem scenarios must reflect local socio-economic, environmental, and cultural realities to maximize relevance and student engagement.

(ii) Teacher Training: Capacity building to equip educators with skills to adapt pedagogical approaches and technology integration fitting the local teacher profiles and resource availability.

(iii) Resource Adaptation: Modification of technological and material resources to align with infrastructure disparities and funding constraints in different regions.

(iv) Inclusivity Measures: Tailoring strategies to address gender, socio-economic, and linguistic diversity, especially in traditionally underrepresented populations.

(v) Alignment with Educational Systems: Adjusting assessment methods, curriculum frameworks, and progression pathways to comply with national standards and qualification frameworks.

(vi) Multi-stakeholder Collaboration: Engaging local communities, industries, and policymakers to support contextualized implementation and sustainable scaling.

These considerations ensure that evidence-based STEM education models maintain effectiveness and equity when expanded beyond their original settings.

Question 5:

How should governments, educational institutions, enterprises and international organizations define their respective roles in cultivating STEM talent and collaborate? Which collaborative mechanisms have shown initial effectiveness, and in which areas is there room for improvement?

Prof. Dr. Christoph Meinel:

Governments, educational institutions, enterprises, and international organizations each play distinctive but complementary roles in cultivating STEM talent, and effective collaboration among these stakeholders is crucial for success.

Roles and Collaboration:

(i) Governments: Define policy frameworks, provide funding, create national and regional STEM strategies, coordinate cross-sector STEM initiatives, and establish governance structures like STEM Executive Panels to align educational reforms with industry needs.

(ii) Educational Institutions: Deliver quality STEM curricula and training, focus on teacher professional development, implement innovative pedagogies, and engage in evidence-based research to improve STEM learning outcomes.

(iii) Enterprises: Provide industry insight on skills demand, contribute resources such as internships, mentoring, and access to technology infrastructure through STEM foundries, and actively participate in curriculum co-development.

(iv) International Organizations: Facilitate cross-border knowledge exchange, support capacity building and funding in developing regions, and foster transnational programs, alliances, and micro-credentials in strategic STEM sectors.

Effective Collaborative Mechanisms:

(i) Multi-sector STEM Ecosystems: Structures that connect schools, businesses, nonprofits, community organizations, and policymakers to create inclusive and relevant STEM learning environments have shown strong impact, benefiting millions of learners.

(ii) Government-led Initiatives with Public-Private Partnerships: Examples like the U.S. Defense STEM Education Consortium (DSEC) and European STEM Education Strategic Plan provide coordinated governance, funding, and network-building.

(iii) Joint Transnational Programs and Micro-Credentials: Leveraging university alliances and vocational centers to pool resources and coordinate STEM offerings enhances upskilling and reskilling efforts.

(iv) Data-Driven Coordination and Evaluation: Dedicated systems to monitor and evaluate STEM program effectiveness ensure continuous improvement and alignment with labor market needs.

Areas for Improvement:

(i) Scaling and Localization: More tailored adaptations are needed to align programs with diverse cultural and educational contexts without losing effectiveness.

(ii) Inclusiveness and Equity: Enhancing representation of underrepresented groups remains a priority, requiring targeted interventions.

(iii) Cross-Sector Communication: Streamlining communication and collaboration processes to reduce silos across stakeholders could improve efficiency.

(iv) Funding Sustainability and Resource Sharing: Developing sustainable funding models and mechanisms for sharing infrastructure and expertise at scale remains challenging.

(v) Enhancing International Collaboration: Greater coordination across countries and regions to share best practices, research, and scalable models would strengthen global STEM talent development.

These roles and collaborations reflect an emerging consensus from ongoing strategic plans and federal initiatives, which highlight governance, partnerships, continuous learning, and ecosystem building as pillars for cultivating capable and diverse STEM talent globally.

Question 6:

What issues do you consider most pressing regarding the ‘equity challenges’ in STEM education, such as gender disparities, regional resource gaps, and educational safeguards for special groups? What actionable interventions are available?

Prof. Dr. Christoph Meinel:

The most pressing equity challenges in STEM education today include gender disparities, regional resource gaps, and safeguarding education for special groups such as those with disabilities or from marginalized backgrounds.

Gender Disparities:

(i) Women remain significantly underrepresented in STEM, accounting for only about 28-35% of the STEM workforce and graduates globally, with lower representation in regions like the EU, India, and Japan.

(ii) Contributing factors include persistent stereotypes associating STEM with masculinity, lack of female role models, unconscious bias, challenges balancing work-life demands, and structural barriers like pay gaps and funding inequality.

(iii) Effective interventions include early encouragement of girls in STEM via role models and mentorship programs; fostering inclusive and bias-free learning environments; promoting female leadership and visibility; providing flexible career pathways; and addressing systemic inequities through policy reforms.

Regional Resource Gaps:

(i) Many regions face disparities in access to quality STEM education resources, qualified teachers, infrastructure, and technologies.

(ii) Low-income and rural areas often lag behind urban centers, exacerbating inequities in STEM participation and outcomes.

(iii) Actionable solutions focus on targeted investments in infrastructure, teacher training, digital access expansion, contextualized curricula, and partnerships with local communities and industries to ensure relevant STEM learning.

Special Groups Educational Safeguards:

(i) Students with disabilities or from underrepresented ethnic and socio-economic groups often encounter barriers in STEM education, including inaccessible learning environments and lack of tailored support.

(ii) Interventions involve ensuring universal design of curricula and facilities, differentiated instructional approaches, assistive technologies, supportive policies, and community engagement.

Cross-cutting Interventions:

(i) Promoting diversity and inclusion initiatives at all levels of STEM education to dismantle systemic biases.

(ii) Developing gender-responsive pedagogies and inclusivity training for educators.

(iii) Creating mentorship and networking platforms for underrepresented groups.

(iv) Collaborations between governments, NGOs, private sector, and international organizations to deploy comprehensive STEM equity programs.

(v) Empowering girls and women with digital literacy and leadership opportunities to bridge the digital divide.

These interventions are supported by evidence from initiatives worldwide such as UNESCO's capacity-building in Africa, Chile's National Gender Equality Policy in Science and Technology, and global mentorship programs, which have demonstrated measurable improvement in representation, skills development, and engagement among equity-challenged groups in STEM.

Question 7:

If you had to summarize the future direction of global STEM education using three keywords, what would they be? Why?

Prof. Dr. Christoph Meinel

The future direction of global STEM education can be effectively summarized with these three keywords:

(i) Personalization: AI and machine learning technologies are driving highly personalized learning experiences tailored to each student's strengths, weaknesses, and pace. This approach enhances engagement and mastery in STEM disciplines by adapting content and assessment in real time.

(ii) Interdisciplinarity: STEM education is evolving to embrace integrated STEAM approaches that combine science, technology, engineering, arts, and mathematics. This fosters creativity, innovation, and problem-solving skills, especially by addressing global "grand challenges" like sustainability and climate change.

(iii) Equity: There is a growing commitment to inclusivity and diversity, ensuring all students regardless of gender, socio-economic status, region, or ability can access high-quality STEM learning. Equitable access to resources, culturally relevant pedagogy, and targeted support measures are prioritized to widen participation and success in STEM fields.

These keywords capture the ongoing transformation in STEM education that leverages technology-enabled customization, cross-disciplinary learning frameworks, and inclusion strategies to prepare learners worldwide for complex, real-world challenges and the future workforce.

Question 8:

International cooperation is vital for addressing shared global challenges. Taking the establishment of the UNESCO International Institute for STEM Education in Shanghai as an opportunity, how might we further strengthen international collaboration?

Prof. Dr. Christoph Meinel:

The establishment of the UNESCO International Institute for STEM Education (IISTEM) in Shanghai represents a landmark opportunity to further strengthen international collaboration in global STEM education.

Key strategies to leverage this institute for enhanced international cooperation include:

(i) Serving as a Global Network Hub: IISTEM can act as a central platform to connect STEM education experts, policymakers, educators, and researchers worldwide for knowledge exchange, joint research, and best practice sharing.

(ii) Promoting Inclusive and Equitable STEM Learning: Designing and disseminating inclusive STEM frameworks and pedagogies across diverse cultural and economic contexts to bridge global participation gaps.

(iii) Coordinating Capacity Building and Teacher Training: Offering international professional development, fellowships, and workshops to unify and elevate STEM teaching standards globally.

(iv) Enabling Collaborative Innovation and Pilot Programs: Facilitating multinational pilot projects that test new STEM curricula, digital tools, and interdisciplinary learning models.

(v) Supporting Policy Dialogue and Governance: Creating forums for governments and international organizations to align STEM education policies with sustainable development goals and innovation ecosystems.

(vi) Catalyzing South-South and Triangular Cooperation: Helping developing countries share experiences and co-develop STEM solutions tailored to their unique challenges.

(vii) Leveraging Shanghai's Strategic Position: Utilizing Shanghai’s vibrant scientific community, advanced infrastructure, and multinational business presence to attract partnerships, investments, and STEM talent exchanges.

With its mandate spanning early childhood to lifelong STEM education, IISTEM’s collaborative, research-driven, and inclusive approach aims to propel global education transformation, scientific progress, and sustainable development. Its presence in Asia-Pacific complements existing UNESCO centers, creating a more balanced and expansive global network supporting shared goals.

In sum, the IISTEM in Shanghai can be a catalyst for deeper international STEM collaboration by fostering connectivity, innovation, inclusivity, and policy coherence across borders to address humanity’s shared education and technological challenges.